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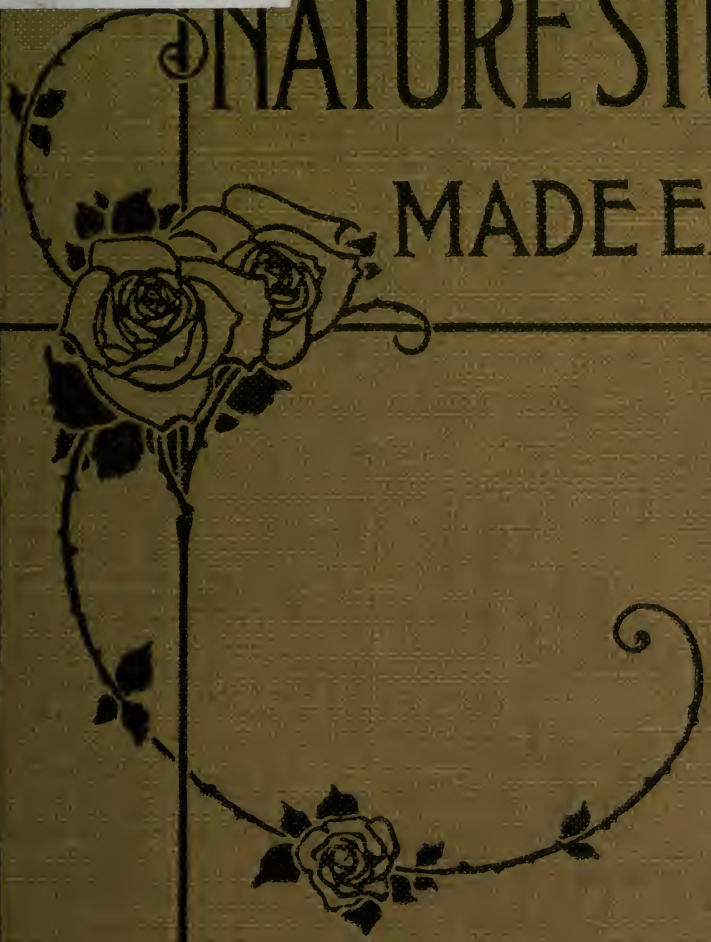
NATURE STUDY MADE EASY



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NATURE STUDY MADE EASY

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NATURE STUDY MADE EASY

BY

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AND

WINIFRED T. CULLEN

PRINCIPAL PUBLIC SCHOOL NO. 56, BROOKLYN, NEW YORK CITY

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Set up and electrotyped. Published March, 1908. Reprinted August, 1908; January, 1909.

Norwood Press
J. S. Cushing Co. — Berwick & Smith Co.
Norwood, Mass., U.S.A.

PREFACE

The position of Nature Work in the school curriculum is established. It has passed the experimental stage. Its value as an educational factor is recognized.

The object in introducting "Nature Study Made Easy" into the classroom is twofold: —

(*a*) To make easy for the teacher the task of bringing the child of ten or eleven years of age to realize some of the elementary truths of Nature seen in the world of plants around him.

(*b*) To make intelligible to the child, by exercising his observation and exciting his interest, the wonderful lessons that the Plant World daily unfolds to him.

In view of this fact much illustrative matter is brought before the class. Pupils are directed to gather their own materials and bring them to the classroom, to work out and record their own experiments, to grow their own plants. This puts a personal element into the study.

The lessons are given in a simple, pleasing manner; a second lesson, in different form, sometimes following the first, to impress or fix it.

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The lessons, though grouped according to the subjects to which they relate, may be given in any order; the lesson on Mushrooms, for example, at a season when mushrooms can be easily obtained, and the lesson on Trees either in Spring or Autumn, as the teacher wishes to study them under the Spring or Fall aspect.

At the end of each lesson is a suggestion for an oral or a written language test. This may be given in the form of a composition written under two or more topics, or in paragraphs answering two or more questions. This, of course, can be omitted at the teacher's discretion, but it is a valuable aid in fixing the matter in the child's mind.

The poetical selection, which accompanies most of the lessons, should be read either by the teacher or a pupil, in connection with the lesson to which it relates.

As an Appendix, several "Notes of Lessons" are given to aid the teacher in placing intelligently before the class the matter to be studied. These lessons are given according to the most approved method — in the Herbartian style, and the inductive form. The *method* and *illustration* introduce the *matter* to be presented, and the *facts* and *inferences* to be elucidated and deduced.

Feeling the need of such Nature Work, especially in the fourth year of school life, these lessons were prepared and used in a New York City school. They were thoroughly tested by experimental use in the classroom. After two years of trial

the results obtained have been so gratifying as to warrant the preparation of the work in permanent form. It is therefore sent forward with the approval of those who have tested it.

The authors are indebted to the kindness of the publishers named below for the use of the various poems which follow and illustrate the lessons: to Messrs. G. P. Putnam's Sons, of New York and London, for "Strawberries," by Dora Read Goodale, from her volume "Apple Blossoms"; to The Century Company for "Winged Seeds," by Helen Gray Cone (from *St. Nicholas*); to Messrs. L. C. Page and Company for "The Maple," from "Poems," by Charles G. D. Roberts; to Messrs. Small, Maynard and Company for "Fern Song," from "Poems," by John B. Tabb; to Messrs. Lothrop, Lee and Shepard Company for "The Maple Tree's Children," from "Jimmy Boy," by the late Abby Morton Diaz; to Mr. Fred Lewis Pattee for "In the Sugar Camp"; to The Macmillan Company for "The Rose," and "May," by Christina G. Rossetti. "Suppose," and "The Venturesome Buds," by Alice Cary; "Talking in their Sleep," by Edith M. Thomas; and "The Tree," from their edition of "Arne," by Björnstjerne Björnson, are used by special arrangement with Houghton, Mifflin and Company, the authorized publishers of the authors named.

FEBRUARY, 1908.

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NATURE STUDY MADE EASY

LESSON I

NEEDS OF PLANTS: PART I

"Oh, Mary, what a beautiful flower!" cried little Nellie Brown, as Mary Hooper came into the room, holding aloft a delicate pink rose. "Where did you get it?"

"My Aunt Susan gave it to me," said Mary; "she had just brought it from her garden. She gave one just as pretty to Lucy."

"Has it any perfume?" asked Nellie.

"Yes," replied Mary; "smell it," and she held the beautiful pink flower before Nellie.

"How sweet!" said Nellie. "What will you do with it?"

"Oh, I am going to put it at once in water. You know cut flowers cannot live without food, and water is their food."

So saying, she filled a vase with clear water, and placed her pretty flower in it.

"Do you notice, Nellie, how carefully Aunt Susan cut off that rose? See the slant in the stem. She did that, she told me, because it injures the delicate little cells to break them roughly. She said it was always better to cut them obliquely, like this," and Mary showed the lower part of the stem to Nellie. "It gives a bigger surface to draw up the water, for stems need all the nourishment they can get when they are cut from the parent bush."

"I am glad you told me that," said Nellie, "I shall always cut flowers, hereafter, instead of breaking them."

"How pretty it looks in the glass there, holding up its head, as though it wished to say, 'Good morning, I am glad you like me.'

Good morning, pretty rose," said Mary; "I do like you, but I am going now to have a run; I will come back again to look at you." Then the two girls ran merrily into the garden.

"Do you know," said Nellie, "I can never tell which I like best among flowers. Roses are beautiful, but lilies, too, are so graceful and spotless. It is hard to decide between them."

"That is true," said Mary. "That reminds me of a pretty poem I once heard recited in school.

"There were two little girls, who were fond of flowers; one loved the lily, and one loved the rose, and they could not decide which they liked best. Ruth said she loved the rose, and

Edith said she loved the lily; so they each brought their favorite flower to school and asked their teacher which she thought was prettier. The teacher could not choose between them. 'The blushing red rose in all its beauty is the emblem of love,' said the teacher, 'while the peerless lily in all its grace is an emblem of purity. I cannot decide; let us join them together, girls, where the red of the rose will contrast with the snowy whiteness of the lily, and put them in this vase.' Then she taught the girls this poem, which they recited in school."

The Lily and the Rose

Ruth. "Tell me, sister, tell to me
Which the flower most dear to thee.
Does the lily or the rose
Most to thee its charms disclose?"

Edith. "I would twine the lily fair
'Mid the tresses of my hair
And I would my heart should be
The emblem of such purity."

Ruth. "I, the blooming rose would twine,
Grace and beauty should be mine
And the power to impart
Fragrant incense round the heart."

Edith. "Why I love the lily bell
Is because its blooms can tell
Innocence and truth are powers
In this lovely world of flowers."

Ruth. "Why the blooming rose I prize
Is that nothing 'neath the skies
Blooms to which a power is given
Greater than this gift of heaven."

Edith and Ruth. "Twine the lily with the rose,
Still as emblems, they'll disclose
Truth and beauty, peace and love,
Sent to earth from heaven above."

—SELECTED.

LESSON II

NEEDS OF PLANTS: PART II

"Come, Susan, come, Alice, it is time for tea; Ned and Tom are here, and mamma says the table is ready."

"Oh, Mary, may I bring your pretty pink rose to put on the table for our tea party?" asked Louisa, and so saying, she placed the vase with the freshly cut rose on the center mat.

"Oh, is that your rose?" asked Lucy, who had just come in. "How lovely it looks. I must run and fetch mine." She returned in a few minutes with a sad face, holding in her hand the now faded flower that had been so beautiful in the morning. The leaves were shrunken, the color had faded, the stem was limp.

"Why, what is the matter?" asked the children; "is your rose dead?"

"I do not know. I left it on the window sill, and how different it is from Mary's."

"Oh, that is because you did not put it in water. Plants must have constant food to live, just as we must have. The food of the cut plant is water."

"Do all flowers require water to live?" asked Edith.

"Yes, cut flowers do, but growing flowers require more. They want soil, sunshine, and water. This is one reason why cut flowers fade so quickly. They cannot get from the water all the nourishment they want, while the growing bush can get food from the soil. Soil holds much water, and the water contains many dissolved minerals, like chalk and potash, that serve to feed the plant. Then it must have rain water as well as soil water, and we must remember that sunlight is necessary."

"Yes, that is true," said Tom. "Do you remember, Fred, those potatoes that sprouted last year in our cellar? The sprouts were white, but when we brought them up and put them in the sunlight, they turned green."

"Then is that why celery is always white?" asked Lucy. "Please pass me some. I will try to see if I can taste any sunlight on it."

"I think the sun must help a great deal to give the taste to the things we eat," said Tom, "for we have to put a great deal of salt on celery to give it flavor."

"Well, I shall remember in the future to give a plant what it needs, and when I get another rose I will not starve it," said Lucy.

Application

What have you learned from this story?

Plants need light, soil, and air to grow.

The green in the plant is made under the sunlight.

Plants grown away from the sunlight are yellow or white and sickly.

Cut plants need water to keep them alive.

Flowers should be cut, not broken, because breaking destroys the tiny food cells.

The Rose

The Rose is Love's own flower, and
  Love's no less
  The Lily's tenderness.
Then half their dignity must Roses yield
  To Lilies of the field!

Nay, diverse notes make up true harmony;
All-fashioned loves agree:
Love wears the Lily's whiteness, and
Love glows
In the deep-hearted Rose.

—Christina G. Rossetti.

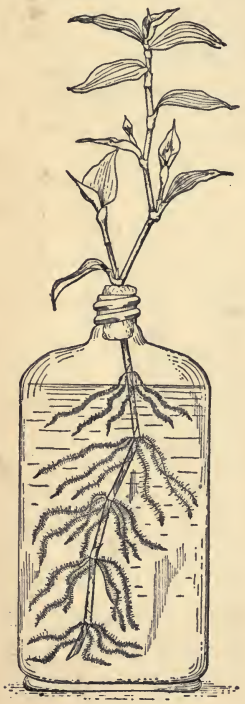
LESSON III

THE PLANT THAT GREW IN WATER

What would this world be without flowers? How readily they grow! Only a little sunshine, a little brown mold, and a few drops of moisture, and they bloom and fill our homes with color. Some plants do not require even these three things. Did you ever see a plant that could grow without soil? Once a little girl whom I knew heard her teacher tell in class that she knew of a plant which would grow without mold. The teacher told the class to find it during vacation. The little girl looked around during vacation, and one day in September she brought to school a few sprays of tradescantia. Some people call it inch-plant. I wonder why? Perhaps because the leaves grow about an inch apart. Some call it the wandering plant. I suppose that is because it grows so rapidly.

The girl brought some sprays of the plant to school and put them in a bottle, and the teacher placed the bottle high up where all the class could watch it. They looked each day to see

what would happen, and very soon they were delighted to see little white *silky* roots growing out from the end of the stem. These roots pushed down into the clear water, and soon the class noticed silky threads growing on the roots. These were the little root hairs which fed the *rootlets* with water, and these rootlets fed the stem of the tradescantia. They watched it all through October, and counted the new leaves that appeared. In the early morning the sun shone on it, and the pretty green leaves lifted up their heads to catch his rays. The children greatly enjoyed watching it grow, and many of the girls who found the plant growing in places near the school also planted it in water.



CUTTING OF WANDERING PLANT

It was very interesting to see how roots formed in water, and how willing they were to do their work, and make the leaves grow.

Could you not gather some of these pretty sprays and plant them in water?

CLASS WORK

Tell the story of how the tradescantia, or inch-plant, grew in water. Find a spray and put it in water. Watch it grow. Notice the rootlets growing. What color is each rootlet? What is the use of the root hairs to the little rootlets?

The Green Things Growing

Oh, the green things growing, the green things growing,
The faint sweet smell of green things growing!
I should like to live, whether I smile or grieve,
Just to watch the life of my green things growing.

Oh, the fluttering and the pattering of those green things growing,
How they talk each to each, when none of us are knowing;
In the wonderful white of the weird moonlight,
Or the dim dreamy dawn when the cocks are crowing.

— D. M. Mulock.

LESSON IV

HOW A RED GERANIUM GREW

They were glorious red blossoms that appeared on Aunt Susan's geranium plant. There were five petals of a bright color on each corolla; they grew out from a little green calyx, formed also of five sepals. She was very proud of the blossoms, and Tom and I often admired them.

Aunt Susan's Geranium

It was the month of August, and Aunt Susan told us that we might have a geranium of our own, if we would promise to take care of it. She said she would give us each a

GERANIUM SLIP

"*slip*" when she cut it down for the winter. One day in early September she cut from the strong, healthy plant two slips. Tom and I stood by and watched her as she slipped off the young shoots. First she prepared a flower pot. She put in several small pieces of china to form a drain and cover the round hole at the bottom of the pot and she almost filled it with loose, fine mold. Next she prepared a place for the slip by pushing down into the mold a round stick. Then she put in the new slip, and pressed the soil tightly round it to hold it firmly, and to touch it at every point. After watering it, she cut off the large leaves near the bottom of the slip. Tom guessed the reason.

"It is because the leaves would send off more water than the plant could take up so soon," said he.

"Quite right," replied Aunt Susan. "The plant wants help at first until it has taken root."

We placed it in a shady, dark, but warm place and left it there. In about a week we knew the little slip had begun to form rootlets, for the leaves held themselves up to the light, and a tiny new leaf was bursting from a bud. We brought it into the sunlight and all winter we watched it. It did not make many new leaves, but it looked healthy.

THE SLIP GROWING

In the spring it had many new leaves, and one day in May Tom discovered a flower bud. Yes, it was a red one! We watered it more frequently now, for we know a plant requires much water when it blossoms. Our care was rewarded, for a few days later the buds opened, and we had a spray of lovely red geraniums with six flowers on it, just like Aunt Susan's. Other buds came and more red flowers grew. They bloomed all summer, and in the fall we did as Aunt Susan had done. We slipped off six healthy shoots and gave them to our friends.

What do you think they did with those shoots? What would you have done, if you had received them?

Language Lesson and Application

Cut a geranium slip and plant it.
Tell the story of its planting and growth.
Which slips are chosen?
When is the plant slipped? Why?
Why is it at first put in a shady place?
Why do geraniums turn toward the light?
What would happen if the geranium received no sunlight?

The Use of Flowers

God might have bade the earth bring forth
Enough for great and small,
The oak tree, and the cedar tree,
Without a flower at all.

He might have made enough, enough,
For every want of ours;
For luxury, medicine, and toil,
And yet have made no flowers.

The ore within the mountain mine
Requireth none to grow,
Nor doth it need the lotus flower
To make the river flow.

The clouds might give abundant rain,
The nightly dews might fall,
And the herb that keepeth life in man
Might yet have drunk them all.

Then wherefore, wherefore were they made
All dyed with rainbow light,
All fashion'd with supremest grace,
Upspringing day and night —

Springing in valleys green and low,
And on the mountains high,
And in the silent wilderness,
Where no man passeth by?

Our outward life requires them not,
Then wherefore had they birth?
To minister delight to man,
To beautify the earth;

To whisper hope — to comfort man
Whene'er his faith is dim;
For whoso careth for the flowers
Will care much more for Him!

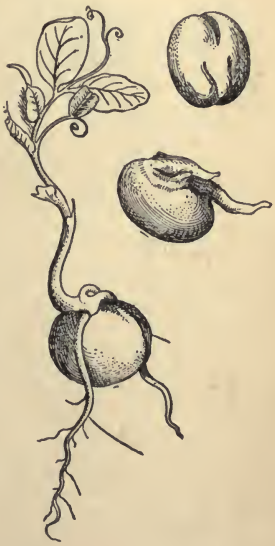
— Mary Howitt.

LESSON V

SEEDS

A seed is a wonderful little thing. It is often very tiny, and yet it contains within itself the beginning or germ of every part of the plant. There are the tiny root, the tiny stem, the tiny leaves, all so small that we can hardly see them. The mighty oak is contained in the shell of a tiny acorn. The great maple is hidden in the wing of the maple seed.

Just drop a seed in the ground. Give it warmth, air, and moisture, and then it has all it needs for growth. Some seeds, like the orange and banana, require more warmth than others, and will only grow to perfection in warm countries. When the seed becomes warm enough, it absorbs the moisture, swells, and bursts its tough coat, and soon the baby plant sends down a root into the ground and a stem into the air.



A Sprouting Pea

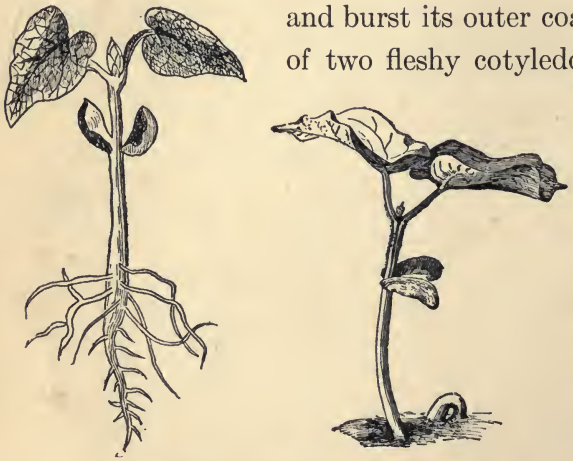
Seeds are divided into two great classes. One has inside of the seed coat only one seed lobe, or *cotyledon*, like the wheat. The other has inside the seed coat two seed lobes, or cotyledons, like the pea or bean. If we soak a bean in water and cause it to swell and thus burst the outer coat, we will

find inside two lobes, or cotyledons, between which lies the baby plant. These cotyledons are thick and fleshy, and are meant to feed the baby plant until it has green leaves and roots of its own, and can feed itself. The plants with one cotyledon are called *monocotyledons;* plants with two cotyledons are called *dicotyledons.*

Parts of Common Bean

Have you ever noticed how the lobes seem to shrivel up as soon as the tiny green leaves appear? The nourishment has all been used up by the baby plant. That is the way all *dicotyledons* commence growth.

Now, if we soak a grain of wheat in water and cause it to swell and burst its outer coat, we will find, instead of two fleshy cotyledons, a mass of starchy white substance all contained in the *one* cotyledon. This cotyledon is meant to feed the baby plant until it has green leaves and can feed itself. That is the way all *monocotyledons* commence growth.



Germination of Common Beans

Again, when we plant the bean plant, we notice it sends up two tiny seed leaves which correspond to the *two* cotyledons.

The wheat plant sends up only one long green leaf which corresponds to the one cotyledon. All grains grow like this, such as wheat, barley, oats, and rye. The leaves, sheathe each other instead of growing out from the stem as the beans, peas, and mustard seeds do. If you want to try this for yourself, just plant some wheat seeds and some mustard seeds in a wet sponge, and watch them for a couple of weeks. The wheat will always send up one leaf, and the mustard seed will send up two. Or you can plant them on wet flannel, or wet sawdust. Keep them in the dark and warmth during the time they are germinating.

Grain of Wheat

Language Lesson

What is a cotyledon?
Why is a bean a dicotyledon?
Why is the wheat plant a monocotyledon?
Draw a bean commencing growth.
Draw a wheat plant commencing growth.
What do all seeds require for growth?
Describe how a bean grows.
Tell what you did to make a bean grow.

Spring is Coming

Spring, where are you tarrying now?
Why are you so long unfelt?
Winter went a month ago,
When the snows began to melt.

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I am coming, little maiden,
With the pleasant sunshine laden,
With the honey for the bee,
With the blossom for the tree,
With the flower and with the leaf.
Till I come the time is brief.

I am coming, I am coming,
Hark! the little bee is humming;
See, the lark is soaring high
In the bright and sunny sky;
And the gnats are on the wing.
Little maiden, now is spring.

See the yellow catkins cover
All the slender willows over;
And on mossy banks so green
Starlike primroses are seen;
And, their clustering leaves below,
White and purple violets grow.

Hark! the little lambs are bleating,
And the cawing rooks are meeting
In the elms, a noisy crowd;
And all birds are singing loud;
And the first white butterfly
In the sun goes flitting by.

Little maiden, look around thee!
Green and flowery fields surround thee;
Every little stream is bright;
All the orchard trees are white;
And each small and waving shoot
Has for thee sweet flower or fruit.

Turn thy eyes to earth and heaven;
God for thee the spring hath given,
Taught the birds their melodies,
Clothed the earth and cleared the skies;
For thy pleasure or thy food,
Pour thy soul in gratitude;
So may'st thou 'mid blessings dwell.
Little maiden, fare thee well.

— Mary Howitt.

LESSON VI

THE TWO SEEDS

Long, long ago, two seeds lay beside each other in the earth, waiting. It was cold and dull, and to pass away the time they entered into conversation.

"What are you going to be?" asked the smaller seed.

"I am not quite sure," answered the other.

"I think I should like to be a rose," said the first seed. "Every one loves the rose. There is nothing more beautiful than a glorious red rose."

"It's all right," replied the second seed, and that was all it could say, for somehow it did not quite know what it would be. So they were silent for a few days.

Then the first seed spoke again. "How warm I feel! I think spring must be here. Some one has poured water on the soil around me. I am swelling! I am growing! Good-by!"

"Good-by," replied the other, and he lay still and waited patiently.

The first seed grew and grew, pushing its head straight up through the soil, till at last it felt that it was in the open air and could breathe.

What a delicious breath it was! Rather cold, but most refreshing! It could see nothing, for it was not a flower yet. The fairies say that plants never see till their eyes come — that is, till they open their blossoms and are really flowers.

So it grew and grew, and kept its head up steadily. It wanted to see the sky, and leave the earth behind and beneath it. But somehow or other, it could not tell why, it felt much inclined to droop.

At length it opened its eyes. It was morning, and the sky was over its head. But, alas! It was not a rose — only a tiny white flower.

It felt much inclined to hang down its head and cry. It tried hard to open its eyes, and to hold its head upright, and to look full at the sky.

"I will be a Star of Bethlehem, at least," said the flower to itself.

But its heart felt very heavy, and a cold wind rushed over it, and bowed it down toward the earth.

There was no other flower in sight, and our little friend felt lonely, for it saw that the time of the singing of birds had not come, and snow covered the land.

It half closed its eyes in terror and dismay at its loneliness. Just at that minute it remembered what the other seed said, and so it repeated: "It's all right. I will be what I can."

So it bent to the wind, and drooped its head to the earth, and looked on the snow.

Then the wind ceased, and the cold passed away and the snow sparkled like diamonds.

The flower knew then that it belonged to the snow, and its name was *Snowdrop*. So it said once more, "It is all right," and then it waited and hung its head after its nature.

A Snowdrop

* * * * * *

One day a pale, sad-looking little girl, with thin face and large blue eyes, came across the path where the flower grew. She spied the pretty Snowdrop, and joyously said, "Ah, my little Snowdrop flower, how glad I am to see you."

She stooped and picked it. The Snowdrop rested lightly on her hand. It gave joy to the pale girl. What a happy end for that flower. In the cold of winter it had made a gleam of summer for a sick child!

* * * * * * * * *

The other seed had a long time to wait. But it grew by and by into a beautiful rose. At last it had the highest honor ever granted to a flower. What was that, do you think?

(Adapted from DAVID ELGINBROD, by GEORGE MACDONALD.)

LESSON VII

THE GERANIUM AND ITS SEED

WILD GERANIUM

Geraniums are well known by their pretty red and white blossoms. They bloom freely and are hardy house plants, but they do not often bear seed in the house. Indeed, we frequently cut off the blossoms to prevent their going to seed. Wild geraniums and geraniums growing out of doors in the summer time *do* bear seeds. Their seeds are very curious, for they cannot fly about like the maple or dandelion, and they are not often thrown about like the apple and peach seeds, but they fall and bury themselves in the ground.

As the geranium has five *sepals* to its *calyx* and five *petals* to its *corolla*, so it has five curious seed pods that grow close together around a common center. Each seed

pod contains one seed, and when the seed is ripe, the pod bursts open and falls off, leaving the seed unprotected. Upon the stem-like part of the pod is a long, feather-like plume, which is attached to the seed. When the pod splits, the seed with this long feather plume attached to it is floated off by the wind. When dry, the plume curls up like a corkscrew, and pushes the seed down in the earth where it has fallen. At the bottom of the seed case are some hairs, or bristles, that point backwards, and hold the seed so it cannot be pulled back out of the ground.

Geranium Seeds

If, after the rain, the seed becomes wet, the plume straightens out, but it cannot be blown away again, as it is now tightly held by the lower hairs, or bristles. Then, if the conditions are favorable, the seed case will swell and burst, and the baby plant within will grow into a new geranium, just as the bean plant and the acorn grow.

We do not often raise geraniums from seed. We generally raise geraniums from slips, as they grow more quickly than from seed and are more healthy.

If you like, you can try this for yourself. Get some ripe seeds, lay them on earth in a flower pot, and watch the seeds bury themselves. Let them dry, then moisten them; then let them dry again and watch how they work. Nature has many beautiful lessons to teach us.

Language Lesson

1. Tell the story of how the geranium seed grew.
2. What is the use of the feather plume?
3. What is the use of the bristles on the seed case?
4. Are geraniums often raised from seed?
5. Why are geraniums raised from slips?

LESSON VIII

ROOTS

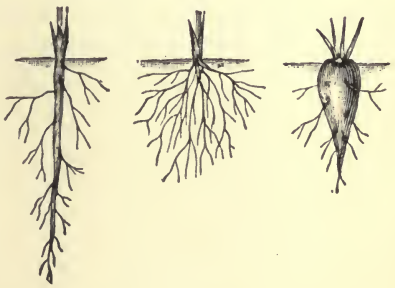
Who has not admired and loved a rugged old oak that has braved the storms of many winters? I often think it must have been a sturdy old oak tree that the poet pleaded for, when he wrote the song, "Woodman, spare that tree." What is it that has helped the brave old oak to live through wind and storm? Is it not its great strong roots that have grown and strengthened from the day they broke through the acorn seed? Yes, the root is the most important part of the plant.

First, it holds the plant firmly in the ground. The wider the branches of a plant spread above, the farther the roots spread below the ground. The roots enable the plant to stand the shocks of storms and winds.

Second, it carries food to the plant. A plant cannot move about like an animal to search for food. Its food must be brought to it. Who brings it? The root. All day and all night long the little rootlets are busy pushing their tiny ends through the soil,

sucking up the nourishment that the plant needs. They can only take it in the form of liquid, but in the liquid is dissolved the substance the plant wants, and this liquid the little rootlet sucks up.

Rootlets are wise little things. They never choose the wrong liquid. Wheat plants like potash and lime, and the little wheat rootlets feel around for water that has these things in it. Then they send the water up to the big root, which sends it up through the stem to the leaves. Here it is digested, or changed into just what the wheat plant needs for its growth. So it is with the rootlets on the oak roots.



Each little root hair and each little rootlet is like a little mouth taking in food for the big tree.

When the roots of a big tree spread out wide in search of water food, the branches above ground also spread out. Then the rain which falls on the branches drops off just at the ends of these great spreading limbs, and right over the places where the thirsty little rootlets are waiting to drink it in, and so the plant is fed from above by the air, sun, and leaves, and from below by the great, sturdy, helpful roots. Think of this when next you pass under a tall oak tree, and look out for its strong, sturdy roots, which are holding the great tree in place. See how they have forced their way through the earth under your feet, displacing soil and stones.

Woodman, Spare that Tree

Woodman, spare that tree!
Touch not a single bough;
In youth it sheltered me,
And I'll protect it now.
'Twas my forefather's hand
That placed it near his cot;
There, woodman, let it stand,
Thy ax shall harm it not.

That old familiar tree,
Whose glory and renown
Are spread o'er land and sea —
And wouldst thou hew it down?
Woodman, forbear thy stroke
Cut not its earth-bound ties;
Oh! spare that aged oak
Now towering to the skies.

When but an idle boy,
I sought its grateful shade.
In all their gushing joy
Here, too, my sisters played.
My mother kissed me here,
My father pressed my hand —
Forgive this foolish tear,
But let that old oak stand.

My heartstrings round thee cling,
Close as thy bark, old friend;
Here shall the wild bird sing,
And still thy branches bend.

Old tree! the storm still brave;
And, woodman, leave the spot,
While I've a hand to save,
Thy ax shall harm it not.

— GEORGE P. MORRIS.

LESSON IX

LEAVES, SEEDS, STEMS

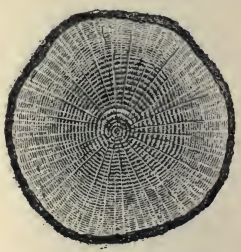
In one of our lessons we learned that some plants grow from one cotyledon and are called *monocotyledons*, like the wheat; while others, like the bean, grow from two cotyledons and are called *dicotyledons*. To-day we will find another difference. When the bean plant has grown for a month or more, and its leaves are large enough, pull one off, and hold it up to the light and examine how the veins run. You will see a thick vein, or midrib, running down the center of the leaf from the base to the apex; and on each side of it you will find smaller tiny veins running out, crossing and recrossing like a fish net. These are called *net-veined leaves*. All dicotyledons have leaves like these: the apple, the plum, the strawberry, and most of our shade trees, like the maple and the oak, have net-veined leaves.

NET-VEINED LEAF

Now when the wheat or grass plant has grown for a month, and its leaves are large enough, cut one off, hold it to the light, and examine the way those veins run. There seems to be no central vein, or midrib, but all the veins run from base to apex in parallel lines just like threads. These are called *parallel-veined* leaves. All monocotyledons have leaves like this: rye, wheat, barley, and all grasses are monocotyledons. Nearly all plants belonging to the lily class, like lilies of the valley and the Easter lily, have parallel-veined leaves.

Parallel-veined Leaf

If the stem of an oak tree be cut across, it will show rings — one for each year of its growth. All dicotyledons have stems marked in rings, and many are valuable as timber.



Cross Section of Oak, showing Annual Rings

If the stem of a palm tree be cut across, it will not show rings, but a hard bark, with soft tissue inside. All monocotyledons have stems like this, and are of little value in building.

Cross Section of Monocotyledon

You can see a cross section of any of these trees at any museum, or you may pick up pieces in a timber yard. It will please you and interest you to notice these things, and you will learn many delightful truths about the world of plants in which we live, and about the wonderful ways of Nature.

Class Work

Bring in a cross section of a stem of a dicotyledon.

What is the name of your specimen?

Bring in a leaf of a dicotyledon; of a monocotyledon.

Notice the veining. Try to draw the veins of the maple leaf; of the lily leaf.

Which of the monocotyledons do you oftenest see?

The Voice of the Grass

Here I come creeping, creeping everywhere;
By the dusty roadside,
On the sunny hillside,
Close by the noisy brook,
In every shady nook,
I come creeping, creeping everywhere.

Here I come creeping, creeping everywhere,
All around the open door,
Where sit the aged poor,
Here where the children play,
In the bright merry May,
I come creeping, creeping everywhere.

Here I come creeping, creeping everywhere;
In the noisy city street,
My pleasant face you'll meet
Cheering the sick at heart
Toiling his busy part,
Silently creeping, creeping everywhere.

Here I come creeping, creeping everywhere;
When you're numbered with the dead
In your still and narrow bed,
In the happy spring I'll come,
And deck your silent home,
Silently creeping, creeping everywhere.

— Sarah Roberts Boyle.

LESSON X

HOW STEMS GROW

Have you ever noticed how bravely the flowers hold up their heads in the bright sunlight? What is it that supports the flowers and leaves? It is the *stem*. The stem of the plant holds up the leaves so that the sun may shine on them and the air pass around them. The stem holds up the flowers so that the sun may color them and the honey bees may visit them. The stem also carries to the leaves the sap food from the root.

Sunflower

Stems are all sizes—from the delicate little stem of the maiden-hair fern, to the strong, huge trunk of the great oak tree. Stems differ in texture. Some, like the geranium stem, are soft and fleshy; others, like the stem of the oak, are hard and woody.

Stems not only differ in texture and size, but they vary in form. Most stems are round and smooth, like the stem of the rose. Some

STEM OF ROSE

STEM OF WALLFLOWER

STEM OF SWEET PEA

are angular, like the dead nettle and wallflower. Some are flat, like that of the sweet pea and the vetch. Have you seen these plants?

Then, again, all stems do not grow in the same way. Some grow erect and straight, like the geranium, and hold up their leaves and flowers. Most stems do this. Some stems, like the morning-glory, support themselves by *turning* round any pole or support that comes in their way which will hold them up. Sometimes the long slender stems of the leaves themselves twine and hold up the leaf, as in the garden nightshade.

Some stems grow so long that they cannot hold themselves

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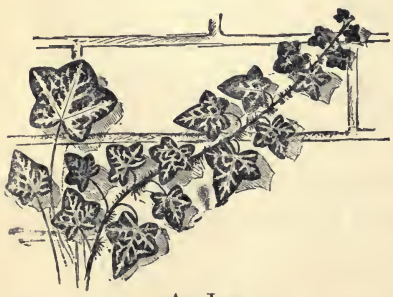
MORNING GLORY

GARDEN PEA

STEM OF NIGHTSHADE

erect, so they send out little tendrils, that *climb* and coil around supports. Have you ever noticed the tendrils on the stem of a kidney bean, or on the stem of a garden pea? Do so, and you will be delighted with the pretty coil they make. Some stems, like the ivy, throw out rootlets, which fasten themselves into any hole

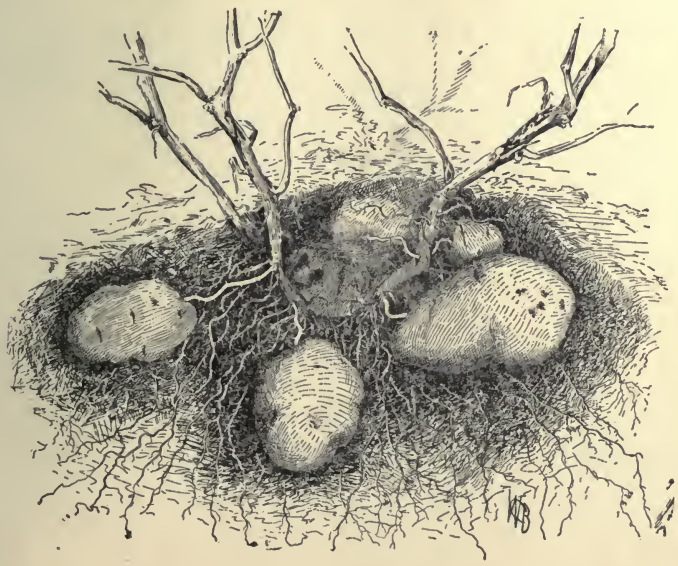


AN IVY

or crevice, and climb up a wall that way. Some plants, like the wild rose, climb by means of thorns, which hook on to neighboring plants, and so lift up the leaves and flowers. These are called *climbing* stems.

Strawberry Runner

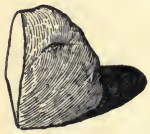
Have you noticed how the strawberry stem grows? That *creeps* along the ground, and every now and then in its journey the run-



ner sends down little buds. These buds produce roots, which feed new strawberry plants. The difference between a tendril and a runner is that the runner produces on its tip a leaf bud, while the tendril does not.

Here is a strange truth: some stems do not appear above ground. Like the root, they grow under the ground. They are called *underground stems.*

The potato, which we all know so well, is the tuber of an underground stem. It stores up in itself nourishment for the new leaf buds, which will later produce new potato plants. You have seen these leaf buds on the potato. They are called "eyes."



Seed Piece of Potato

The onion, too, is an underground stem, full of nourishment for its new plant. We take advantage of this stored nourishment, and cook it for our own table. So you see underground stems are useful articles of food.

In some other lessons we will talk again about stems.

Topics for Composition

Why stems grow erect.
Why stems climb.
How they climb.
Why stems creep.
Underground stems.

May

There is but one May in the year,
And sometimes May is wet and cold;
There is but one May in the year
Before the year grows old.

Yet though it be the chilliest May,
With least of sun and most of showers,
Its wind and dew, its night and day,
Bring up the flowers.

— Christina G. Rossetti.

LESSON XI

HERBS, SHRUBS, AND TREES COMPARED

Plants differ from each other, in size and shape, in color and duration of life. Some plants, like the bean and pea, have a short life. They grow from seeds, and produce leaves, flowers, and fruit all in one season. Then their work is over, and they die. These plants have soft, succulent stems. They love the bright sunshine, but cannot stand the cold frosts of winter. They are called *herbs*.

Herb

A Shrub

Most of our vegetables belong to this class, like the cabbage, pea, bean, potato. Many of our flowers, too, are herbs, like the daisy, the buttercup, and the corn-flower.

Some plants, like the myrtle, do not die at the end of one season. During the summer they blossom, flower, and produce seed, and during the winter they live on and brave the frost. They do not grow very high, but send out many branches and leaves, and make a bushy appearance. They have strong, woody stems, which resist the cold. These are known as *shrubs*. Shrubs add much beauty to a landscape, and we love to plant them on our lawns or in our parks.

Trees are not stunted in their growth like shrubs. They grow higher and higher each year. Their trunks become rounder and firmer and stronger as winter approaches. Though their leaves fall, they mark their dropping place by leaving behind a leaf bud, which next season buds forth into new leaves and new branches. Notice them on the maple, the oak, the peach, the apple, and other trees.

So, while herbs live only one year, and so are called *annuals*,

shrubs and trees may live many years, producing new branches and buds. They are called *perennials*. Some trees live hundreds and hundreds of years. They are stronger and more hardy than any other of their fellows in the world of Nature. There are trees still growing in our western forests that were growing there when Columbus discovered America. Think of it! What a story they could tell!

A Tree

Language Lesson

Make a list of herbs that you have seen growing.

Make a list of shrubs that you have seen growing.

Make a list of trees that you have seen in parks, or on the city streets.

Why are trees called perennials?

The Venturesome Buds

Last autumn, when Winter was taking
His last cozy nap in his bed,
And each little leaf bud was sleeping,
With blankets pulled over its head,

We crept halfway out of our cradles;
The sun kissed us sadly; the air
Was colder, by far, than we liked it;
The pines whispered softly — "Beware!"

But just then old Winter came roaring
And rushing down over the hill: —
At the first awful blast of the trumpet
Our poor little hearts stood still.

He clutched us so with cold fingers
We nearly were choking to death;
And rustled us so with his breezes
We came near to losing our breath.

And then growing tenderer towards us,
He made us white hoods, warm and nice,
And fastened them under our noses
With quaint little buckles of ice.

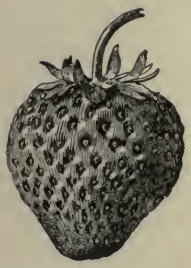
But, an hour ago, a dear bluebird
Perched here on our trembling spray,
And sang, and sang, and sang, and sang,
Till he sang old Winter away.

Now we must each meet the springtime
With a frost-bitten nose or an ear.
We shall sleep like all the sensible buds
When Winter comes round next year.

— ALICE CARY.

LESSON XII

LIFE HISTORY OF THE STRAWBERRY



What a luscious fruit is the ripe red strawberry!

In a wild state, its creeping vines cover the hills and meadows, and the fruit makes welcome food for the birds and insects. When cultivated, its pretty runners cover our gardens, and its luscious berries give us a delicious dessert for our tables.

How does it grow? Let us follow its life history.

You may see the strawberry seeds in great numbers dotting the red-cushioned fruit. They are hard and gritty. Inside each is a baby strawberry plant.

FLOWER OF STRAWBERRY

We do not often raise strawberries from seeds, for they would take too long to grow. The strawberry plant is generally propagated by runners.

As soon as the warm sun comes out, the strawberry plant sends up its pretty three-

leaved stems. Soon snow-white blossoms appear, with five delicate petals.

Numerous yellow stamens, bearing heads of *pollen*, are seen within, while numerous *pistils* grow up to receive the pollen.

Now, buzzing in the summer sun, come the busy bees, seeking for honey in the sweet-scented flowers. They carry the pollen from blossom to blossom, and the seeds begin to ripen. Each of these strawberry pistils has a separate seed box, and within this seed box grows the seed.

Top of Flower Stalk Swelling

Now the blossom falls off, and the top of the flower stalk begins to swell, bearing the little brown seeds on its surface. It swells more and more, growing big, and red, and juicy, and forms the delicious strawberry we find so welcome in early summer.

Meanwhile the busy plant has been throwing out its long, pale runners in all directions.

The little runners feel around on the moist earth, till they find a suitable place.

Then they form roots which sink into the earth, and commence growth as new plants.

Strawberry Runner

Now comes the gardener to cut them from the parent plant, and transplant them to make new strawberry plants for next year.

All winter the young plants lie warm underground, and next summer they grow up to bear leaves, blossoms, and fruit, and to send out new runners as the old plant did last year. All runners are not needed to grow strawberry plants, but all should be cut off from the parent plant. If they are left growing, they will draw from the strength of the plant and weaken the fruit.

Look for some wild strawberry plants during your next walk along a country road. You will see them creeping over the mounds among the grass.

Language Lesson

Write the life story of the strawberry.
How is the strawberry propagated?
How are the runners formed?
What is done with them?
Tell the life history of a strawberry runner.

Strawberries

When the fields are sweet with clover,
  And the woods are glad with song,
When the brooks are running over,
  And the days are bright and long,

Then, from every nook and bower,
Peeps the dainty strawberry flower.
When the dear, enchanting summer
Tosses beauties at our feet,
She delights each weary comer
With her berries, fresh and sweet:
Springtide's blossoms, stored away,
Ripen for us all to-day.

— Dora Read Goodale.

LESSON XIII

LIFE HISTORY OF A MAPLE

The maple is one of our most beautiful shade trees. That is why our avenues are lined with them. Just outside our schoolroom window is a row of young maples. We love to watch them in the early spring, when their leaf buds burst forth under the warm sun. They grow larger and larger, and greener and greener each day.

All through the hot summer months they grow, kindly shading the sidewalks from the burning sun, and giving homes to the happy little birds who live in their branches. In autumn, when the sun's rays become weaker, the green coloring in the leaves changes into red and yellow, and other beautiful colors. One of the most beautiful sights in our woods is the appearance of the maple trees in autumn.

The maple blooms early in the summer, but its flowers have no petals; only stamens and pistils. Often one maple tree will have all *staminate* flowers, and another maple tree will have all *pistillate* flowers.

The flowers hang on slender threads and look like fringes. This is to enable the wind easily to blow the pollen from the staminate flowers on to the pistillate flowers, to ripen them. The staminate flowers then disappear, but the pistillate flowers form seeds, which are almost as pretty as the flower fringes.

Maple Key Maple Fringe

The seed of the maple is called a *samara*, and consists of a seed pod with a wing. Generally two pods grow together, but when they are thoroughly dry and ripe, they fall apart. The wings are thin and light, and are easily carried to a distance by the wind, till they fall to the soft earth and sink into the ground. There they lie all winter, but as soon as spring returns, and the note of the bluebird is heard, the little brown seeds swell under the warm rays of the sun, and burst their seed coats and send up a pair of green leaves. This is the new maple tree. The root grows downward, and by and by a seedling appears.

Maple Seedling

As the months go by, new green leaves are formed, branches shoot out, and by the fall, another young maple has begun its life work. We should protect these baby trees and help them to grow. Some day they will be branching trees as big as those we now know, and we may be glad to sit under their shade.

Winged Seeds

Oh, gold-green wings, and bronze-green wings,
And rose-tinged wings, that down the breeze
Come sailing from the maple trees!
You showering things, you shimmering things,
That June-time always brings!
Oh, are you seeds that seek the earth,
The shade of lovely leaves to spread?
Or shining angels, that had birth
When kindly words were said?

Oh, downy dandelion wings,
Wild-floating wings like silver spun,
That dance and glisten in the sun!
You airy things, you elfin things,
That June-time always brings!
Oh, are you seeds that seek the earth,
The light of laughing flowers to spread?
Or flitting fairies, that had birth
When merry words were said?

— Helen Gray Cone in *St. Nicholas.*

LESSON XIV

KINDS OF MAPLES

There are many varieties of maple.

One of the most common is the *Red Maple*, which generally grows along streams and swamps, but is sometimes planted along streets and in parks.

RED MAPLE

It blooms earlier than the crocuses or pussy willows. The flowers come out before the leaves. They grow in bright red tufts all over the tree. Some of them have little balls covered with yellow dust. These are the staminate flowers. Some have tiny red plumes on each flower. These are the pistillate flowers. When these pistillate flowers are ripe, they become "Maple Keys." They bloom in March and are ripe in May.

MAPLE KEY

The Red Maple bears *palmate*, or hand-shaped, opposite leaves and a two-winged fruit.

The *Silver Maple* is a tall tree with a pale bark, which flakes off in thin scales. The leaves are silvery white underneath, with deep, sharp notches. Like the Red Maple, it blooms early. The flowers and leaves come out together, and the seeds fall in October. The leaves are nearly round, with a few large notches. The wood is hard and tough and close grained.

SILVER MAPLE

The *Striped Maple* has a light green bark striped with dark lines. The wood is dark and fine, but it does not grow high unless it is grafted upon another maple tree.

Staminate Flowers and Pistillate Flowers of Maple.

The *Mountain Maple* is shrubby in growth. Its leaves appear before the flowers, and they grow in long spikes at the ends of the twigs.

The Great Maple Trees of Northern America have leaves which are sometimes a foot broad. Think of that!

Some of our prettiest articles of furniture are made from the "Bird's-eye Maple," and the "Curly Maple." When the wood is polished, it has lights and shades like the folds of a satin gown. Have you ever seen it?

Suggested Work for Class

Have children bring in leaves from the different maple trees. Draw them. Dry and press them.

Name ten articles of furniture made from the maple tree.

Write a description of the red maple and the silver maple.

For what are bird's-eye and curly maple used?

Why do maple leaves turn red in the Fall?

Draw a maple key and describe it.

*The Maple**

Oh, tenderly deepen the woodland glooms,
And merrily sway the beeches;
Breathe delicately the willow blooms,
And the pines rehearse new speeches;
The elms toss high till they reach the sky,
Pale catkins the yellow birch launches,
But the tree I love all the greenwood above
Is the maple of sunny branches.

Let who will sing of the hawthorn in spring,
Or the late-leaved linden in summer;
There's a word may be for the locust tree,
That delicate, strange newcomer;
But the maple it glows with the tint of the rose
When pale are the springtime regions,
And its towers of flame from afar proclaim
The advance of winter's legions.

* * * * * * .

— CHARLES G. D. ROBERTS.

LESSON XV

THE SUGAR MAPLE

Maples make beautiful shade trees, and some species grow to a large size. For these reasons we plant them along our avenues and streets and grow them in our parks and public resting places.

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One of the most beautiful and largest of the maple family is the *Sugar Maple*. It is not only valuable as a shade tree, but yields a delicious sweet syrup from its sap.

Sugar Maple

The trees are grown in groves for this purpose. In the spring of the year, when the leaves are forming, and the sap is ascending, the bark of the tree is "tapped"; that is, a hole is bored through the bark into the wood beneath, and a little wooden tube or spout is driven into the hole. A pail is hung beneath, to catch the sap as it runs out. Sap runs best when the days are warm and the nights are cold.

The sap is collected in large kettles and boiled to syrup. Then it is known as maple syrup. Sometimes it is allowed to boil longer; then it is poured into molds and made into maple sugar. Just before it is ready to turn to sugar, it makes a delicious "wax." Boys sometimes pour this hot, thick syrup on snow, and when it thickens into a sticky paste, they eat it. They say it is better than any kind of candy.

Tapping a Sugar Maple

A great deal of sugar is made in the New England states, where the sugar maple grows abundantly.

In early days, maple sugar was the only sugar used. Sometimes the sap of other trees, as birches and elms, is made

into syrup, but it is not as plentiful, nor as good, as maple sugar.

The wood of the maple is, as we have said, valuable for ornamental furniture. One sugar maple gives a pretty satin wood, dotted all over with round spots, caused by knots in the wood.

A Maple Sugar Grove

It is known as "Bird's-eye Maple." Another sugar maple gives a pretty wood, with wavy, shining lines made by irregular streaks in the wood.

Maple wood is light in color and light in weight. It admits of a high polish, and is used for light articles of furniture, chiefly for bedroom furniture.

Language Lesson

Write a description of "How Sugar is obtained from the Maple Tree."

In the Sugar Camp

The sun is pouring from a cloudless sky;
The glittering snow o'er stream and field and hill
Will bear our weight; there's summer in the air;
But ah! how bare the leafless wood and still!

There's scarce a breath to stir the maple trees;
There's not a wildwood voice or bird afloat
Save the low alto of the chickadee, —
But hark! Hurrah! the bluebird's joyous note!

And oh! the sun, the flooding, golden sun!
The roof trees pour their floods beneath its beams,
And from the maples come the gay drip-drop
Of sap on every hand in limpid streams.

The sun rolls high. The snow no longer bears.
The roads are swimming o'er with bubbling streams.
The tubs are filling in the sugar bush,
Drip-drop, and every drop like crystal gleams.

And now the steers. Leap on the hogshead, boys,
'Tis now high time the gathering was begun;
The snow is deep, but every maple tree
Must yield its pail of sweet ere set of sun.

And next the boiling. Through the whole long night
The foaming pans pour out their clouds of steam;
And when the darkness falls among the trees,
The fires send o'er the snow their ruddy gleam.

* * * * * * * * *

— Fred Lewis Pattee.

LESSON XVI

THE MAPLE TREE'S CHILDREN

One windy day in March a maple tree awoke from her winter sleep. "Oh, Mother Nature," she cried, "I am shivering with cold. My limbs are bare and ugly. Spring is coming, and the birds will be returning from the South. I want to look pretty and inviting, so that they will want to build their nests in my branches. They will not come to me, for I have no leaves to hide them."

Kind Mother Nature smiled—a knowing smile. Suddenly there was a gentle movement at the ends of the twigs, and all along the branches of the maple tree. The flower buds burst, and sent out long stumps of catkins. The leaf buds opened and covered the maple with clusters of leaves. The maple tree was happy. Birds came to build their nests in her branches; and a pair of robins and a family of thrushes sang sweet songs all day.

How pretty her green leaves looked! The wind whispered pleasant things to them, till they fluttered and danced with joy.

When the leaves were hot or dusty, Mother Nature sent cooling raindrops to refresh them. A happier tree could not be found.

"Thanks, thanks, Mother Nature, for your kindness and care," said the maple; "I will spread my leaves and make shade for the school children."

* * * * * * * * *

Summer passed, and all its joy. By and by autumn came, with its gloomy skies and chilling winds. The maple tree grew sad, for she heard her little leaves sighing: "We shall surely die — we shall surely die!"

"My dear little leaves!" sighed the maple tree. "Poor things, they are fading and drooping. Are they going to die?"

"I will make their death beautiful," said kind Mother Nature. Then she sent the sun behind clouds, and the leaves changed their color to gold and scarlet and russet brown.

"How beautiful!" said every one. At last, one cold morning, the maple tree stood all bare with her pretty brown and red leaves heaped on the ground.

"Dear, pretty things," she said, "how I shall miss you. No one will care for me now."

Just then, a merry crowd of school children came along, talking of red berries and autumn leaves.

"Do you think there is any beauty in a tree without leaves?" asked a little girl.

"Indeed I do," replied another girl. "Look up through the maple. Its branches make a lovely picture against the blue sky." The girls all looked up to see the tracing of the branches against the sky.

"Ah," said the maple tree, "that will be pleasant to dream about during the winter." For she felt her long winter nap coming on, and the buds nestling closer to the branches.

Just then there was a gentle rustling around her trunk. "Dear

mother tree!" cried the little leaves on the ground. "She has taken care of us all summer. Her roots and stems have fed us. She has held us up to the sun, and been a good mother to us. Now, we will do something for her. We will gather close to her trunk and keep her warm. Then we will sink into the ground and turn ourselves into food to feed her, when she wakes up after her long winter nap."

So saying, they gathered closer to the maple tree. The rains beat them into the ground, and the winds blew the loose earth over them, and then they turned into food for the old maple tree.

When she wakes up in the spring, she will be happy, and will soon clothe herself again with pretty blossoms and leaves.

— Abbie Morton Diaz, Adapted.

Language Lesson

Tell *or* write a story telling: —

1. What did the Maple Tree want? Why?
2. What did Mother Nature do for her?
   - (*a*) In spring
   - (*b*) In summer
   - (*c*) In autumn
   - (*d*) In winter.

October's Party

October gave a party;
The leaves by hundreds came,
The Chestnuts, Oaks, and Maples,
And leaves of every name.

The sunshine spread a carpet,
And everything was grand,

Miss Weather led the dancing,
Professor Wind the band.

The Chestnuts came in yellow,
The Oaks in crimson dressed,
The lovely Misses Maple
In scarlet looked their best.

All balanced to their partners
And gayly fluttered by;
The sight was like a rainbow
New fallen from the sky.

Then in the rustic hollow
At hide-and-seek they played,
The party closed at sundown
And everybody stayed.

Professor Wind played louder;
They flew along the ground,
And then the party ended
In hands across, all round.

— GEORGE COOPER.

LESSON XVII

THE OAK

The oak is called the "Monarch of the Forest." Just as the lion is the king among animals, so the oak is the king among trees.

What great, strong, sturdy branches he bears! How gnarled and rugged is his trunk! Yet once he was a little acorn, and lived in a little cup.

Oak trees will grow in any kind of soil. They like best the soft soil, into which they can send down their long roots — deep, deep. They must spread their roots, too, for the mighty branches with their many leaves and flowers and acorns need a great deal of support and many roots to feed them.

Although oak trees will grow almost anywhere, they do not like cold, wet places, nor the borders of ponds and marshes. They grow best in forests in temperate climes.

The oak does not bear acorns until it is about eighteen years old, but this is babyhood for an oak, for the oak tree has many years to live, and grow, and strengthen. Some oaks live to be a thousand years old.

An Oak Tree

Oak wood is very hard and close and firm. Each year's growth pushes the rings of wood closer together and adds to the value of the wood. For this reason it is used for the hulls of ships.

Much of our furniture which is subjected to hard usage is made of oak because it is so tough and strong. Dining-room chairs and tables are often made of oak.

There are many kinds of oak trees. It is a pleasant occupation to go into a wood and gather leaves from the different oaks, and notice the differences in the bark of the trees.

Notice, too, how plants cling to the old oak trunks. The ivy leans against it, soft mosses creep over it. It is so strong, it supports them all.

The Brave Old Oak

A song to the oak, the brave old oak,
Who hath ruled in the greenwood long;
Here's health and renown to his broad green crown
And his fifty arms so strong.
There is fear in his frown when the sun goes down
And the fire in the west fades out;
And he showeth his might on a wild midnight
When the storm through his branches shout.

Chorus

Then sing to the oak, the brave old oak,
Who hath stood in his pride so long,
And still flourish he, a hale green tree,
When a hundred years are gone.

He saw the rare times when the Christmas chimes
Were a merry sound to hear;
And the squire's wide hall and the cottage small
Were full of Christmas cheer;
And all the day to the rebeck gay,
They carol'd with gladsome swains.
They are gone, they are dead, in the churchyard laid,
But the brave tree still remains.

— H. F. Chorley.

LESSON XVIII

LIFE HISTORY OF AN OAK

In the autumn, when the leaves begin to fall from the oaks, the little acorns fall too. They nestle in the grass, or roll down into a furrow, or strike on the soft ground under the tree. The rains beat on them, and some of the acorns are partly buried in the ground. If they are not eaten by insects, or carried away by squirrels, they sink deeper and deeper, and rest under the soil.

Oak Seedling

In the first warm days of spring the little acorn begins to swell. Then it bursts its coat and begins to sprout. Up shoot the two tiny seed leaves into the air, and down goes the baby rootlet into the soil. During the first few years the tiny oak makes little growth. A few leaves appear on a slender stem. Now it is an *oak sapling*. Each year it grows only about a foot, but it is busy making root, trunk, branches, and leaves. The bark on the trunk is smooth at first. As the sapling gets older and the wood grows outward, the bark cracks with the strain, and long fissures are made in it.

It is many years before the oak produces a flower. These appear before the leaves in early spring and are called "oak-catkins." Have you noticed the long, slender, graceful clusters hanging on the branches of a tall oak? These are the staminate flowers. They

hold the pollen. Above them you will find some little urn-shaped flowers, which stand upright. They are the pistillate flowers.

Staminate Flowers of Oak

Soon the pistillate flowers begin to ripen, and all summer long they feed on the pollen. When autumn comes, they are rewarded. There, snugly seated in their little urns, or cups, are the acorns. These are the fruit. The acorn ripens and falls, but the tree does not die. It lives for many, many years, doing the same good work, blossoming, ripening, shedding crops of acorns. It gives shelter to man, it gives homes to the birds; and then, when it is finally cut down, it is used in making ships, houses, and articles of furniture.

Pistillate Flower of Oak (magnified)

Language Lesson

Tell the life story of an oak: —

The seed. How it was planted.

How it grew, — the flowers, the acorn, seedling, tree.

The Oak Tree

The oak tree was an acorn once,
  And fell upon the earth;
And sun and showers nourished it,
  And gave the oak tree birth.

The little sprouting oak tree!
  Two leaves it had at first.
Till sun and showers had nourished it,
  Then out the branches burst.

The little sapling oak tree!
  Its root was a tiny thread,
Till the kindly earth had nourished it,
  Then out it freely spread.

On this side and on that side,
  It grappled with the ground,
And in the ancient, rifted rock
  Its firmest footing found.

Then sing for the oak tree,
  The monarch of the wood;
Sing for the oak tree,
  That groweth green and good;

That groweth broad and branching
  Within the forest shade;
That groweth now, and yet shall grow
  When we are lowly laid.

— Mary Howitt.

LESSON XIX

TOM'S ACORN

"At last, at last, I have cheated the squirrels!" merrily cried Tom Brown, as he stooped and picked up a big brown acorn that lay under a bunch of leaves.

"Why, what have you done?" asked his cousin William, who was busy hunting for maple wings under an old maple tree.

"I have found an acorn, a big one, a ripe one. It was such hard work to get it, for those busy little nut gatherers have been around picking up their winter stores, and I have had a long hunt for this."

"What are you going to do with it? Will you eat it?" asked William.

"Why, Will, how stupid! Boys don't eat acorns; pigs and squirrels do that. I am going to make an oak tree out of it."

"An oak tree out of that little nut!" exclaimed William, who had not learnt anything about acorns.

"Why, yes," replied Tom; "this great tree, under which we are standing, grew out of an acorn like this. My teacher told me so."

"Oh, that can hardly be true!" said William; "that thing is too small to make anything so big."

"Well, we shall see," said his cousin. "Seeing is believing." Then pushing his acorn safely to the bottom of his pocket, he and

William both hurried home, for night was falling, and they had quite a long distance to go.

The next day was Saturday, and Will was up early to see Tom plant his oak tree. "First, let us get a pickle bottle and fill it with water," said Tom.

"Now, Will, hold the acorn while I tie a string round it. Next, we will tie it over the bottle so that it will just hang in the water. Now, let us put it in the sunlight and see what will happen."

"This is great fun!" said William. "How long before the oak tree grows?"

"Oh, we must wait a while," said Tom; "the air and heat and water must work upon the seed and cause it to swell; then it will burst its outer skin, and the little plantlet will begin to grow."

THE OAK TREE THAT GREW IN A PICKLE BOTTLE

"A plant inside, a real plant?" asked Will, who could not understand how a little plant could live in so small a space.

"Yes," said Tom; "our teacher told us that a baby plant lives in between the seed leaves and as soon as it can it will grow like its mother. Now we will leave it and try to be patient."

Some days later Tom nearly ran over William, who was on his way to the ball ground. "Come, Will, come back, my tree is beginning to grow."

"You don't mean it," said Will; "I *must* go with you." But Tom was right; the seed had burst its coat, and the little rootlet was pushing its way into the water. Looking more closely, they found two tiny green leaves pushing upwards.

"Now that it is started," said Tom, "I will set it in a pot of soil. It will want more food than it can get in water."

Tom did so, and Will and he watched it all through the spring and summer months. By autumn, to their delight, they found it had grown into a little plant, which was pushing out roots and was too big for the pot.

Then Tom took it out of the pot and planted it in the garden. It is still growing, and Will is beginning to believe that perhaps it may some day be an oak tree.

Language Lesson

Tell: How Tom found the acorn.
How he put it in the pickle bottle.
How he put it in a pot of soil.
How he planted it in the garden.
What do you think will become of it?

LESSON XX

KINDS OF OAK TREES

The more I learn about trees the more I like them. I see them in the winter, when their leaves have fallen, and I can study how their branches grow. I see them in the spring, when the buds begin to swell. I watch their tiny blossoms as they cover themselves with yellow pollen and change into winged seeds. I love to see them scatter and fly before the wind. I see the leaves unfold and cover the trees with green, and then change to yellow and brown and red and scarlet.

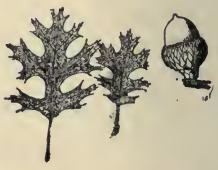
A Tree in Winter

Oak Bud

Every tree is a friend of mine, and I want to learn the names of each, and their manner of life and growth. I think I love the oak best. It reminds me of strength and dignity. I believe I could pick out the different oak trees by their leaves, buds, and bark.

The *White Oak* leaf is slightly lobed, and is narrow at the base. The bark is thin and scaly, and, when it is old, peels off in strings.

White Oak



Scarlet Oak

The *Scarlet Oak* leaf is deeply cleft. It turns brilliant red in autumn. The wood has a reddish tinge.

The *Black Oak* leaf is cleft and pointed, and the bark is darker and rougher than the red oak. The wood has an orange tinge. This oak is valuable for the tannin, which is used in the manufacture of leather.

The *Bur Oak* has lobed leaves, but its bark is thicker and rougher, and does not scale off like the bark of the White Oak. The White Oak forms its acorns in one season.

Black Oak

Bur Oak

Red Oak

The *Red Oak* requires two seasons to grow its acorns. Every oak bears many hundreds of crops of acorns during its long life. There are oaks growing in America now that were growing when Columbus discovered our continent in 1492. Think of it!

Suggested Work for Class

Visit the park, and bring in leaves from the different oak trees.
Visit a museum, and see the leaves pressed. Press yours.
Draw a leaf of the White Oak, the Red Oak, the Black Oak.

The Tender Beech and the Sapling Oak

For the tender beech and the sapling oak,
That grow by the shadowy rill,
You may cut down both at a single stroke,
You may cut down which you will.

But this you must know, that as long as they grow,
Whatever change may be,
You can never teach either oak or beech
To be aught but a greenwood tree.

— Thomas Love Peacock.

LESSON XXI

TOM'S LOG

"Hello! I have just been looking for you," cried the merry voice of Jack Hart, as he spied the back of Tom Brown's coat in a timber yard. "What are you doing here? You will be late for school."

"No, I won't," said Tom; "there are twenty minutes yet. I was passing by here when I noticed that cross section of a log over there, and I want to get it."

"Now, boys, don't linger here. You will be late for school," came from the other end of the yard, and Mr. West, the manager, appeared at the door of his office.

"Please, sir, may I have that piece of wood yonder? It looks like a cross section of a dicotyledon. We are learning about that now," said Tom.

Cross Section of Oak, showing Annual Rings

"Certainly," said the good-natured manager. "You are right, that is part of an oak stem. If you count the rings, you can find out how many years it has been growing."

"Thank you, sir," said Tom, as he placed his prize under his arm.

That morning Tom entered school a happy boy. He was the first to bring in a cross section of a log, though the boys had all been hunting for them for a week. He showed it to his teacher, who was pleased at the boy's readiness, and promised to tell the class more about his log. That afternoon, the teacher showed the piece of oak brought in by Tom, and, to make it clearer, drew the section on the blackboard. She told the boys that woody stems are made up of *pith*, *wood*, and *bark*. The *pith* is in the center, and is soft in the young plant, but, as the tree grows, it pushes the wood inward, and hardens until it is hardly notice-

End of a Log

able. The teacher showed the place where the pith had been. The boys quickly guessed that the wood near the pith was the hardest, because it was the oldest and driest. She told them timber men call it the "*heartwood.*"

Then the teacher pointed out the *bark,* or outside layer of the tree. Inside the bark she showed an inner skin which is called *bast,* and is made of stringy fibers of wood. Gardeners use this for tying up plants. Between the bark and the white wood she pointed out a sticky layer. This, she told the boys, was the important part of the stem, for in that layer all the new wood was formed. This is the growing part of the stem. Each year it builds up a ring of wood. This wood is lighter than last year's ring, so that, by counting the rings, one can guess rightly just how many years the tree has been growing.

1, Bark; 2, Ring; 3, Pith

"Then a ring is formed each year," said Tom.

"Right," replied his teacher. "Now, you can imagine that as the growth goes on all the time, the stem must expand and grow bigger and bigger, until the bark can no longer bear the strain. It cracks in all directions, and sometimes peels off."

"I have often noticed how rough is the bark of most trees."

"New bark grows, however," said the teacher. "It is formed by the living layer called the *cambium layer.* If this layer be destroyed, the tree will surely die."

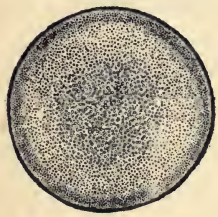
"What are those lines running across from the pith to the bark?" asked Tom Brown, who had eyes for everything.

"I don't believe you will remember if I tell you," said his teacher; "those are called *medullary rays*. They are formed of lighter wood, and give strength to the stem. Carpenters like them, for they give that grainy look to furniture which makes it so pretty. They are found in woody dicotyledons."

"Have all trees stems like that?" asked George Hall.

"Oh, no; only trees that grow from dicotyledons, like the oak, the maple, the plum," replied his teacher.

"Trees that grow from monocotyledons have stems like this;" and she showed a cross section of a palm tree, while one of the boys drew it on the blackboard. "Here, instead of a pith and medullary rays, there are only smooth bark and loose wood.



Cross Section of Trunk of Palm Tree

"In dicotyledons the *bark* is soft and broken, and the *heartwood*, or central wood, is strong and firm. That is why these trees are chosen for building purposes.

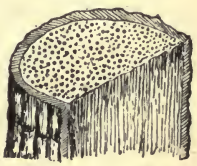
"In monocotyledons the bark is hard and strong, while the center is soft and pulpy, because the growth is all outward against the bark, and the wood is pressed closer and closer outward.

"Dicotyledons grow outward, and are called exogens.

"Monocotyledons grow inward, and are called endogens.

"I will tell you a true story to prove this fact," said the teacher. "Two workmen had been employed for many years in felling timber

in Canada. There, most of the trees are exogens, and yield very slowly to the saw. The bark is the softest, and the cutting gets harder as one nears the *heartwood*. These men were later employed to cut timber in the West Indies. Here most of the trees are endogens, and the bark wood is hard, while the interior is soft and easy to cut. But these workmen knew nothing of this. Accordingly they started at their work. They worked hard for an hour without any success. 'I give it up,' said the first; 'there's no cutting through this.'



Cross and Longitudinal Section of Monocotyledon Stem

"'Right,' said his comrade; 'if this is the outside, what must the inside be? I give it up, too.' If they had only known as much as Tom Brown, they might have finished their task.

"Bamboo and sugar cane have no bark. Their hardest wood is on the outside. They are only giant grasses."

Language Lesson

Draw a cross section of an exogen six years old.

Draw a cross section of an endogen six years old.

What is the heartwood? Which trees are most valuable for building? Why?

LESSON XXII

LIFE HISTORY OF A PEACH

PEACH BLOSSOMS

The peach is one of the most beautiful fruit trees. Its lovely mellow fruit appears smiling among the dark green leaves in the early fall. How delicious it is! We eat the juicy fruit and throw away the hard, dented kernel that we find inside. This is just what the peach wants us to do. That hard stone contains a very precious seed. In that seed is the baby peach tree. If a peach stone falls in a suitable place, it will by and by be pushed into the moist ground. There it will lie all winter.

In the spring the warm rays of the sun will reach through to it; the rains will moisten it, and by and by the hard stone will separate into two halves, and the real seed will be found inside. By and by the tough skin will burst, and the little baby peach tree will push down its tiny rootlets into the ground, and will send up its tiny leaves into the air. In a short time more leaves will appear, held aloft on a stem about one inch high. The rootlets will push down the same distance into the ground. After a few years it will bear blossoms and fruit. The first fruit found on the tree is small and sour.

The best peaches are obtained by "budding" or "grafting."

I will tell you what "budding" means. A bud is cut from an old tree which bears peaches. An opening is made in the bark of the new peach tree, and the bud is inserted. The top of the little peach tree is then cut away, and the bud grows into another and stronger peach tree.

When this tree grows strong, it is transplanted, and in the third summer it bears lovely pink peach blossoms. These blossoms produce fruit, and we have the ripe, rich, juicy peach. We gather these peaches for our tables, but the stones we throw away to find a suitable place to start life for themselves.

SHIELD BUD.

THE BUD GRAFTED.

THE BUD TIED

LESSON XXIII

THE PEACH TREE'S STORY

One day in August, little Florence Stanwood stood under a shady peach tree, looking up at the red and yellow fruit. A gust of wind shook the tree, and threw down into her hand a large, red, ripe peach. "Oh, you pretty peach!" cried Florence; "you are too lovely to eat. I wish the tree would talk to me, and tell me from where you come."

"Would you like to hear my story, little girl?" asked the peach tree. "It is a long one."

"I should like to hear it," replied Florence; "I will not move till you have finished."

"Five years ago," said the peach tree, "a rosy peach was found by a little girl like you. She ate the ripe, juicy part, and threw away the hard stone on the ground, near by. It lay there a little while, then it sank into the ground. The rain fell on it, and it sank deeper and deeper. All winter it lay underground. In spring, the hard, stony shell burst apart, and inside was a little brown kernel. I was inside that brown kernel, in between two fat seed leaves."

"Poor little tree," sighed Florence; "were you crushed and cold?"

"Oh, no," said the peach tree; "I was half asleep. By and by, the warm sun came out, and I woke up and looked around.

Then I began to move. I pushed out between the seed leaves, and threw down a tiny rootlet; then I pushed up into the air and light, and sent up a tiny leaf. It was lovely! I looked around at the world, and worked hard to put on more green leaves. I drank in the pure air and fresh water. I grew into a seedling."

"What fun," cried Florence; "Did you grow quickly?"

"Yes; so quickly that I could hardly believe it was myself. When spring came again, and I was one year old, a man came one day into the garden, and said, 'I believe this would be a good time for budding this peach tree.' It made me feel important. Then he cut a little opening in my back and pushed in a bud of a bigger peach tree. It grew into a little leaf and looked as if it belonged to me, and I tried my best to grow up tall and straight and handsome."

"Did all that happen in this very garden?" asked Florence.

"Oh, no," replied the tree; "as well as I remember, I was brought here later. At first, I grew in a nursery, with a number of other peach trees. We all stood up in a row like a lot of sisters and brothers, and grew till we were two years old. Then we were dug up and separated. I was brought here and carefully placed in the ground. The soft, moist earth was pressed closely round my roots and I felt quite at home."

"Did you ever have lovely pink blossoms like some peach trees?" asked Florence.

"Yes, certainly," replied the tree; "but not till I was larger and stronger."

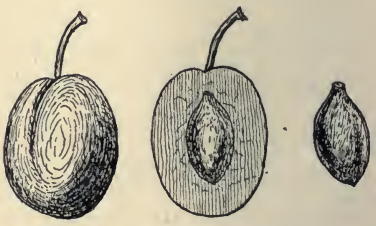
"What an interesting story!" said Florence. "May I take your peach in with me now, that I may tell mamma all about you?" So saying, Florence caught the mellow peach in her soft little hands, and carried it in to her mother.

LESSON XXIV

LIFE HISTORY OF A PLUM

FLOWER OF PLUM

The plum is a juicy, luscious fruit. Have you ever tasted one? Some plums are green, some are purple, some are red. But the juicy, delicious fruit which we enjoy is only a case or protection for the true seed. That is hidden in a hard stone most difficult to crack. This kind of fruit is called a *drupe*.



A PLUM AND ITS SEED

Plums grow on trees, like the apple and peach. They blossom in the spring, grow all summer, and are ripe in the fall. Some we gather and eat. Some drop to the ground and rot. Some are eaten by insects, but in each case the most precious part — the stone — finds its way back to the ground. It contains the seed, which is the baby plum plant. There on the ground it softens, bursts, and in time the seed begins to grow.

We eat the juicy covering and throw away the seed. If it falls in the right place, it will sink into the earth. There it will rest all winter. The seed ripens, and, by the time spring comes, the hard, stony case is ready to split. The seed swells and bursts, and then the baby plant begins to grow, just like the apple seedling.

First, a tiny pair of green leaves appears above ground. Then a tiny root shoots down. Soon this grows into a seedling. This is the beginning of a plum tree.

Our best plums are obtained by grafting a young bud on a good strong tree, just as we graft a peach bud.

The Tree

The Tree's early leaf buds were bursting their brown;
"Shall I take them away?" said the Frost, sweeping down.
"No, let them alone
"Till the blossoms have grown,"
Prayed the Tree, while it trembled from rootlet to crown.

The Tree bore its blossoms and all the birds sung;
"Shall I take them away?" said the Wind, as it swung.
"No, let them alone
"Till the berries have grown,"
Said the Tree, while its leaflets, quivering, hung.

The Tree bore its fruit in the midsummer glow;
Said the Girl, "May I gather thy sweet berries now?"
"Yes, all thou canst see;
"Take them; all are for thee,"
Said the Tree, while it bent down its laden boughs low.

— BJÖRNSTJERNE BJÖRNSON.

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LESSON XXV

LIFE HISTORY OF AN APPLE

What plant we in this apple tree?
Buds, which the heat of summer days
Shall lengthen into leafy sprays;
Boughs where the thrush, with crimson breast,
Shall haunt, and sing, and hide her nest;
We plant, upon the sunny lea,
A shadow for the noontide hour,
A shelter from the summer shower,
When we plant the apple tree.

Do you know why our own poet, William Cullen Bryant, wrote those lines about the apple tree?

Who has eaten a ripe, rosy apple? Did you enjoy the delicious fruit? Do you know where it grew? Upon an apple tree among many others, also ripe and rosy. Have you ever seen an apple tree growing? It is quite unlike the tall pine or the sturdy forest oak. It is a fruit tree. Apple trees grow in orchards, planted by the farmer. The branches are thick and stout and irregular. The trees do not grow very high.

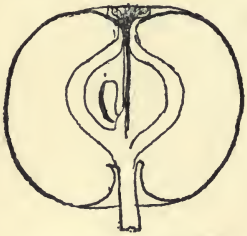
Apple Blossom

In the winter the branches are bare, and you can easily see the short twigs with buds at the end of each. You can tell just how much each twig grows in a year

by looking at the circular scars left by last year's buds. Each bud is covered during the winter with short, glossy scales, with fine, soft wool around the edge to protect the little leaves inside. When the warm spring air touches them, they throw off the woolly, downy covering, and the tiny leaf buds come forth. Then the flower buds burst out, and we see the tree covered with clusters of beautiful white and pink flowers, which make lovely bouquets all over the green tree. Here is a bunch of apple blossoms just come out.

The apple blossoms bloom in the month of May. Then they drop, and the pretty white leaves look like a shower of snowflakes falling in the wind, but they have left behind the most important part of the flower. That is a knob with a number of green leaves around it, and some little spiked stamens standing up in a circle. This is the remains of the calyx, or cup, below which the apple fruit is beginning to grow. It grows and grows, getting rosy and fleshy and juicy, and one day in the fall it has grown into a beautiful round apple. At the top you can still see the dried leaves of the old calyx, which do not fall off.

Some day, when you have a nice round apple, cut it across, and you will see five divisions, or cells, with two little brown seeds in each. When the seeds are ripe, they will fall and sink into the ground, and produce new apple trees, just like any other seed.

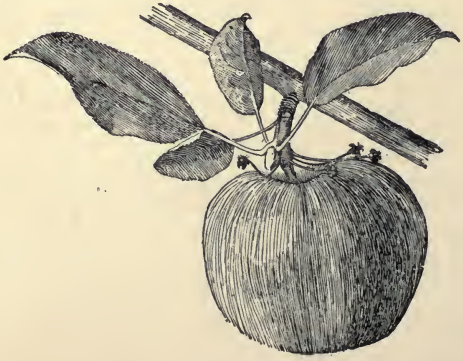


Longitudinal Section

Cross Section

You can plant several of these ripe seeds yourself, and see how soon they will burst and send up leaves.

Apple trees are generally planted in rows in orchards. They are grown for the sake of the fruit, which is sent to the market. Sometimes apple trees are found growing on the roadside. These grow from seeds that have been carried by birds, and usually bear small, wild apples.



LESSON XXVI

THE APPLE TREE

APPLE SPRIG

How pretty is a sprig of an apple tree! Whether it be a sprig bearing spring blossoms, or a sprig showing its winter buds, it is a pleasing sight to behold.

Have you ever noticed the scars on an apple twig? They mark the place of last year's buds. From one scar to another scar marks a year's growth. You can tell the age of a branch by counting its scars.

An apple twig bears two kinds of buds — leaf buds and flower buds. The leaf buds are single, and are protected by soft, fine down to keep them warm in winter. In the spring they burst into pretty green leaves.

The flower buds come in clusters. They are protected by five green sepals covered with down. In the spring they burst out into round, white blossoms. Each blossom has five scented white petals, tinged with red on the outside. They protect the stamens, which are inside, and the very young seeds, which are at the base of the flower.

FRUITING BUDS

As the summer advances, bees visit the flowers, and scatter the pollen, which ripens the seeds.

By and by the top of the flower stem swells till it is round and full, closing in the little seeds which are safely packed away in five little cells, protected by strong walls.

An Apple Tree

In the fall the apple is fit to be eaten. The little seeds are now ripe, and ready to fall out and make new apple trees. We eat the juicy apple, which is the swollen top of the flower stalk, and throw away the core with the hard brown seeds, or pips. This is just what the apple wants us to do. The seeds fall on to the ground, or are scattered by the wind. By and by they sink into the soil, and a new apple tree springs up.

The best apples are obtained by grafting young buds on stocks.

Language Lesson

What kind of tree is an apple tree?
What are the scars on the branches?
What kind of buds do apple trees form?
When do the blossoms form?
When does the fruit form? Tell something about it.

The Planting of the Apple Tree

Come, let us plant the apple tree.
Cleave the tough greensward with the spade;
Wide let its hollow bed be made;
There gently lay the roots, and there
Sift the dark mold with kindly care,
And press it o'er them tenderly,
As, round the sleeping infant's feet,
We softly fold the cradle sheet;
So plant we the apple tree.

What plant we in this apple tree?
Buds, which the breath of summer days
Shall lengthen into leafy sprays;
Boughs where the thrush, with crimson breast,
Shall haunt and sing and hide her nest;
We plant, upon the sunny lea,
A shadow for the noontide hour,
A shelter from the summer shower,
When we plant the apple tree.

What plant we in this apple tree?
Sweets for a hundred flowery springs
To load the May wind's restless wings,

When, from the orchard row, he pours
Its fragrance through our open doors;
A world of blossoms for the bee,
Flowers for the sick girl's silent room,
For the glad infant sprigs of bloom,
We plant with the apple tree.

What plant we in this apple tree?
Fruits that shall swell in sunny June,
And redden in the August noon,
And drop, when gentle airs come by,
That fan the blue September sky,
While children come, with cries of glee,
And seek them where the fragrant grass
Betrays their bed to those who pass,
At the foot of the apple tree.

And when, above this apple tree,
The winter stars are quivering bright,
And winds go howling through the night,
Girls, whose young eyes o'erflow with mirth,
Shall peel its fruit by cottage hearth,
And guests in prouder homes shall see,
Heaped with the grape of Cintra's vine
And golden orange of the line,
The fruit of the apple tree.

* * * * * *

— William Cullen Bryant.

LESSON XXVII

EVERGREEN TREES

Evergreen trees! That is a pleasing name — the tree that is ever green. It does not change its color or loosen its leaves and bare itself in the autumn winds. No, it bravely resists the winds. It tells its pretty green leaves to hold on tightly. It gathers them in little bunches, so that one helps the other to present a brave front, and then, when all the forest trees and fruit trees and shade trees are bare, the evergreen tree is covered with leaves.

Why do the leaves remain green? Why do they cling so tightly to the old mother tree? It is one of Mother Nature's beautiful laws that, when her summer children of the forests fall asleep, her winter children shall keep wide awake and full of life.

Back of the bark of these trees, the pines and the firs, there are pipes and reservoirs of sticky turpentine juice. Each fir has its own way of making its juice. This juice makes the resin and the turpentine and the balsam we use.

Have you ever seen a grate fire piled with pine logs? How it

burns! How bright are the sparks! It is the resin that the plant has stored that burns so brightly. Have you ever made a bonfire of your Christmas tree? After the fun of the present-giving is over, comes the fun of the bonfire. How the leaves crackle and burn!

In olden times, when a torchlight procession was held, the Scottish chiefs used pine torches to light the way.

Have you ever seen amber? It is often cut into beads which are worn as necklaces. Do you know that the piece of amber from which those necklaces were cut was once the juice of a pine tree? Some great pines once grew on the shores of the Baltic Sea, in the north of Europe (some still grow there), and they dropped their gummy juice on the ground. This became hardened by the cold air, and formed into the beautiful transparent stones which we now proudly wear as necklaces and bracelets.

Pine and fir trees are very generous. They give us tar, turpentine, resin, balsam, and amber, while they live, and when they are cut down, they give us wood to make our houses, floors, and desks. Most of our school desks are made from the pine trees.

The wood of the fir tree is not quite as strong as that of the pine, and when cut up it is called "deal." Think of the things that you know are made of deal. Chairs, tables, boxes, floors, are often made of deal.

Most of the evergreen trees grow in the forests or on the hillsides of cold regions.

Suggested Work for Class

Tell the story of an amber necklace.
Find on your maps the Baltic Sea.
How far is it from New York?
Find on your maps places where evergreens grow.
Make a list of things made from the fir tree.
Make a list of things made from the pine tree.

LESSON XXVIII

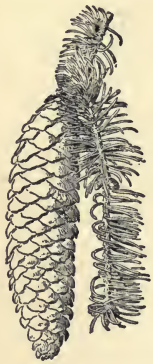
THE PINE FAMILY: PART I

Pine Tree

The pines are the most important evergreen trees. To the pine family belong not only the true pines, but the firs, spruces, hemlocks, larches, and cedars. The leaves on these trees are protected by resin, which is sometimes fragrant, as in the fir balsam. They do not fall at the approach of winter, like the leaves of *deciduous* trees, but they fall at irregular times.

The fruit is called a *cone*. It grows like a twig, only instead of forming leaves, it forms scales, which overlap and flatten and bear the seeds. A pine nut is smooth on the outside. Cut away the

shell, and the kernel looks like a small egg with a cap on one end. Cut this kernel in two, and you will find in the center the tiny



PISTILLATE CONE OF NORWAY SPRUCE

PISTILLATE CONE OF WHITE PINE

PINE SEEDLING

new plant, which is sometimes green at one end. Plant one, and instead of one leaf, like the wheat, coming up, or two leaves, like the maple, a *circle* of leaves will come up.

CEDAR TREE

FIR TREE

SPRUCE TREE

When the young tree begins to branch, *buds* form in a circle, and become a circle of branches. The middle bud is stronger than any of the others, and it forms the trunk of the tree.

The true pine is an evergreen. It has leaves which grow in groups of from two to five wrapped together. The cones are thick and woody. At the base of the leaves are some thin, dry, hard scales.

Pitch Pine

Hemlock

Balsam Fir

The spruce and hemlock have single leaves attached to little ridges on the stem.

I am sure you would like to be able to distinguish the best known members of the pine family, and to know the difference between a true pine, a spruce tree, a hemlock, a balsam fir, a cedar, and a cypress. All these trees bear cones.

Suggested Work for Class

Bring in sprays of the pine, hemlock, spruce, balsam fir, cedar. Draw.
Bring in cones. Compare them. Draw them.
What is the difference between leaves of white pine and hemlock?
What is the difference between cones of the balsam fir and hemlock?

LESSON XXIX

THE PINE FAMILY: PART II

Oak trees bear acorns. Apple trees bear apples. Pine trees bear cones. Just as the acorn holds the seed of the oak, and the apple holds the seed of the apple tree, so the cones hold the seeds of the pine trees. If you lift up the scales on the cone, you will find a winged seed under each scale. When the cones are ripe, the scales open, and the seeds drop out and are caught by the wind. The wind carries them away, and after a while lets them fall, so that they may grow into new pine trees.

There are many kinds of pine trees. Some of them bear large, sweet seeds which are called "pine nuts." The valuable white pine trees which used to grow in the northern part of the United States produced a soft white wood, which could be easily carved. People have thoughtlessly cut down these pine trees.

The pine trees which grow in the southern part of the United States produce a dark yellow wood. It is very hard, and is used for building purposes.

A pine forest is always a delightful place. When the sun shines on the trees, they fill the air with a healthful fragrance.

New Jersey is noted for its pine forests, and people often go to these regions to breathe the rich odor of the pines.

Pine timber is valuable on account of its strength and lightness. It is found in forests all over the world. Germany has many for-

ests of pine. America has forests of yellow pine and white pine, and Canada has forests of red pine.

Every part of the pine tree is of value. The tall timber is useful for shipbuilding. The sap gives tar, resin, and turpentine. The leaves are pressed for their aromatic perfume. The inner bark is used in some countries for food. Pine wool is sometimes made from the leaves. In many countries the seeds are eaten for dessert.

The sap is obtained by cutting the trees, but if the same trees are cut three years in succession, they will die. It is wrong to destroy these valuable trees. So the turpentine makers move their camps at the end of each year, and give the trees a chance to recover their growth.

We should protect our trees and never willfully destroy them.

Language Lesson

What is the seed of the pine called?

Where are the seeds placed?

How are they scattered?

Say something about the different pine trees, — the pine trees of South America, of the northern United States, of the southern United States.

Why is the pine tree of value? Name some uses of the timber, sap, leaves, bark, and seed of the pine.

How is turpentine obtained?

LESSON XXX

FORESTS AND HOW TO PRESERVE THEM

When we study our beautiful native trees, how we learn to love them, and how we wish to preserve and protect them!

America once was famous for her great forests. They were thought to be inexhaustible. But this is a mistake; young timber cannot grow as rapidly as old timber can be cut down.

We depend on our trees for many things. You know timber is required for building, for fencing, for manufacturing. Timber is used for railroad ties and for fuel. The bark of trees is used in tanning leather. Trees are tapped — and often carelessly tapped — for turpentine, pitch, and sugar.

So you see there are many reasons why we should preserve our trees.

Trees not only give us many useful things, but they are helpful to the country at large. They keep off cold winds, and so help to keep the ground warm. In northern Illinois, the climate was so altered by the removal of the forest trees, that the peach crops almost failed. Winter wheat, which failed in open fields, was successful when protected by woods.

In winter, trees keep off the cold winds, and in summer they reduce the heat and lessen the effect of violent storms.

Forests help to attract moisture, and the rain sinks into the ground, and makes springs and streams. These moisten the

earth and make the soil fertile. In this way trees prevent droughts.

Trees, too, make homes for birds. Birds destroy the insects that injure the crops, so trees really increase our crops by sheltering birds.

Trees, by their strong roots, hold together soil and mold, and thus they are useful in preventing landslides.

But, useful though they are, trees are often thoughtlessly cut down. Forest fires destroy many valuable trees.

Our government has taken measures to preserve trees. Every encouragement is given to plant them. The children in our public schools have a day set apart for planting trees. We place them around our schools and in our parks.

Strict regulations are also made to control forest fires and prevent their spreading. Laws are passed to prevent the cutting of trees on public lands. By such means we hope to preserve our young trees.

Boys and girls should do all they can to help our government in saving our trees.

LANGUAGE LESSON

Of what use are forests?

Why should we protect trees?

Give any methods used in our public schools to encourage care of trees;

or

Tell the story of the planting of a tree on Arbor Day;

or

Write a letter to a friend, telling what was done in your school on Arbor Day.

Talking in their Sleep

"You think I am dead,"
The apple tree said,
"Because I have never a leaf to show —
Because I stoop,
And my branches droop,
And the dull gray mosses over me grow!
But I'm all alive in trunk and shoot;
The buds of next May
I fold away —
But I pity the withered grass at my root."

"You think I am dead,"
The quick grass said,
"Because I have parted with stem and blade —
But under the ground
I am safe and sound
With the snow's thick blanket over me laid.
I'm all alive, and ready to shoot,
Should the spring of the year
Come dancing here —
But I pity the flower without branches or root."

"You think I am dead,"
A soft voice said,
"Because not a branch or root I own!
I never have died,
But close I hide
In a plumy seed that the wind has sown.
Patient I wait through the long winter hours,
You will see me again —
I shall laugh at you, then,
Out of the eyes of a hundred flowers."

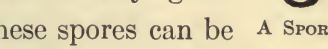
— Edith M. Thomas.

LESSON XXXI

FLOWERLESS PLANTS—FERNS, MOSSES, MUSHROOMS

Ferns, mosses, and mushrooms belong to the lowest order of plants. They do not bear flowers nor real seeds. In place of seeds, they produce a tiny grain called a *spore*. These spores can be found in little brown cases, which look like dots, on the edges of the fronds. They can sometimes be found running lengthwise down the center of the leaflets.

Fruiting Frond of a Christmas Fern



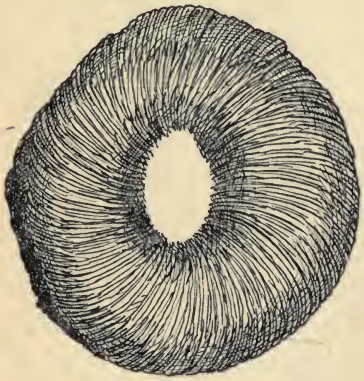
A Spore

In the *Mosses* the spores are borne aloft in little capsules on the top of a long, leafy stem. This capsule is covered with a hood somewhat like a cornucopia in shape. This hood falls off when the spores are ripe. Then the capsule bends over and upsets the spores, which, as they fall on damp ground, begin to take in food. Then they form a kind of scum, which looks like tiny white threads. By and by a bud appears, and from this bud the new moss stem grows.

Moss Capsule shedding Spores

In the *Mushroom*, the spores are found be-

tween the gills. If you place a piece of white paper under a ripening mushroom, you will see lines of these little spores, just as they fell from the gills. When ripe, the spores fall, and form a kind of white, thread-like growth, called *spawn*. After much feeding, this spawn produces tiny balls, or "buttons." These rapidly grow to mushrooms.



Spores and Gills of Mushroom

Fallen Spores

The fronds of the *Fern* are generally of a delicate green, and are gracefully shaped. There are thousands of varieties of these beautiful, graceful plants. They grow in all parts of the world. We consider them to be amongst our most beautiful home decorations. The French bracken, which grows in the British Isles, is celebrated for its beauty. It bears its seeds in spikes. The leaves have a reddish hue. In Ireland it is called "The Flower Prince of Ferns."

Sir Walter Scott, the great writer, found some among the Lakes of Killarney, covering one of the islands, and he exclaimed, "This is worth traveling miles to see."

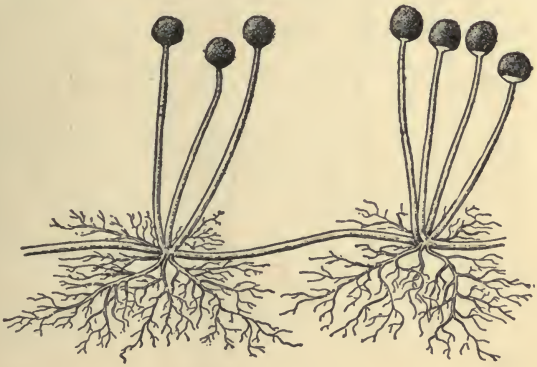
Mosses show various shades of green. Some are white or gray-green, others are dark red or brownish green. Though they do not bear flowers, they are a pleasing addition to the landscape,

covering bare places with velvet carpets and mats of green. Some are so small that they cannot be seen with the naked eye.

Mushrooms are of a lower class, and they are not ornamental in any sense. They are of use as foods, or for flavoring.

Mold, or mildew, which grows on stale bread and other things which are left in the damp, is a sort of mushroom fungi.

True Moss
(natural size)



Black Mold of Bread (greatly enlarged)

Mushrooms, ferns, and mosses are land plants. Though they choose damp, dark places for growth, they must have soil.

We must not confuse the *algæ*, or seaweed, found on the seashore in red, green, or brown masses, with mosses. They are water-plants, not mosses. The algæ bear seeds and flowers. Neither is the "hanging moss" of Florida a true moss. It also bears seeds and flowers. True mosses have neither seeds nor flowers.

Language Lesson

What kind of plants are ferns, mosses, mushrooms?
How do ferns reproduce?
How do mosses reproduce?
How do mushrooms reproduce?
Which of these are ornamental? How?
What is mold?

or

Tell something about the mosses: (*a*) their color; (*b*) their spores; (*c*) where they grow.

Suppose

How dreary would the meadows be
In the pleasant summer light,
Suppose there wasn't a bird to sing,
And suppose the grass were white!

And dreary would the garden be
With all its flowery trees,
Suppose there were no butterflies,
And suppose there were no bees.

And what would all the beauty be,
And what the song that cheers,
Suppose we hadn't any eyes,
And suppose we hadn't ears!

For though the grass were gay and green,
And song birds filled the glen,
And the air were purple with butterflies,
What good would they do, then?

Ah, think of it, my little friends,
And when some pleasure flies,
Why, let it go, and still be glad
That you have your ears and eyes.

— ALICE CARY.

LESSON XXXII

MOSSES

Have you ever walked on Nature's carpet of green moss? No carpet that we make is softer to the feet or more velvety to the touch.

This soft carpet is formed of thousands of tiny plants, growing on short stems. They are the mosses.

Mosses grow in tufts in cool, moist places, — in woods, on the trunks of trees, on rock. They are to be found wherever they can find room and food for their tiny roots.

Here is a patch of moss. It is the month of August, and the moss is in fruit. These tall stalks bear each on the top a capsule or moss spore. Each stalk rises up from the leafy stem, with a capsule covered with a large pointed hood. It looks like a wheat seed turned upside down. If you take off the hood, you will find the capsule with a lid on the end. Lift off the lid with a pin. This is full of dusty powder like pollen. These are the moss *spores,* which will later produce new moss plants.

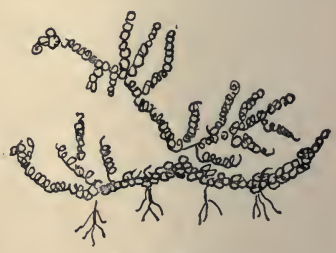
You can see them as a kind of green coating on decayed wood or moist soil. Have you ever noticed them?

Hair Moss

There are very many varieties of mosses. The *Hair Moss* is a wonderful little plant. It grows on the summits of hills or in marshy places. In Lapland it forms food for the reindeer or bedding for the Laplanders. It is soft and elastic, and serves both for bed and covering.

The *Bog Moss* covers deep bogs with its spongy mats and makes good vegetable mold and fertile soil. In Ireland and Scotland the poor use it for fuel.

The *Feather Moss* grows in shady places and is very small. It is said that Mungo Park, the great African explorer, when on his travels once lost his way. He was so wearied and exhausted that he lay down dejected, and was on the point of despair. He was in the midst of a wild country, surrounded by savage animals and savage men. "I was ready to lie down and die," he wrote. Just at that moment his eye fell on a carpet of moss. He picked one of the small plants and examined it. The beauty of the pale green plants, the perfect leaves, all so fondly tended, made him feel that his Heavenly Father, who had formed the tiny plant and preserved it in this desert place, would not abandon him. He gained new hope and strength, and arising, went on his journey.



Bog Moss

Go, then, into the wood and lanes, and collect these beautiful mosses, which strike their tiny roots into the soil, and fix themselves in any crevice they can find. Bring them home and care for them.

These tiny mosses have many uses. They appear before the blossoms, and they remain long after the summer flowers have gone. They make storehouses for wandering insects. The birds use their leaves to build their nests, and they feed on the moss spores. They make rich mold and keep the soil moist around roots of ferns and bushes. Their matted roots protect the rocks on which they grow from falling apart.

Have you ever noticed how difficult it is to pull apart the roots of mosses? Small as they are, the roots strike so firmly into rocks and stone that it is almost impossible to move them.

The Moss

There is a fresh and lovely sight,
A beauteous heap, a hill of moss,
Just half a foot in height.
All lovely colors there you see,
All colors that were ever seen;
And mossy network too is there,
As if by hand of lady fair
The work had woven been.

Ah me! what lovely tints are there
Of olive green and scarlet bright.
In spikes, in branches, and in stars,
Green, red, and pearly white!

— William Wordsworth, Adapted.

LESSON XXXIII

THE MOUNTAIN FERN AND THE MOORLAND MOSS

High on a mountain grew a noble fern. It unrolled its long fronds in the morning light and spread out its graceful leaves on every side. Down on the moor grew a poor little moss, slowly creeping in the shadow of the mountain. The fern looked out in its pride on the lowly moss, and said, "You poor, miserable little thing, how do you live down *there?* I scorn such lowly places."

"I am happy," said the moss, "for I am contented. I prefer the moor to the mountain height. The sun shines on me as it does on you, and the dews of the night glisten on my leaves as they do on yours." She shook her little leaves with such an air of independence, that the dews scattered in all directions.

"Oh," said the fern, haughtily, "I prefer my position. From here I can look out on the whole world."

Just at that moment a strong gale of wind arose. It dried up the roots of the tall fern, and the leaves withered and broke in the blast. Soon after, the sun burst forth in the heavens, and poured its hot rays down on the delicate moss, and the little plant grew pale and weak and faded away. Now the fern and the moss were alike companions in grief.

By and by the fern slowly raised its head and said, "Little sister moss, I am sorry I spoke slightingly to you. Don't you think we had better be friends, and work together to protect ourselves

from our common enemy, the fierce winds? Up here on the mountain they blow so wildly."

"Dear fern," replied the little moss, "I would gladly help you, but I am so badly burned by the fierce rays of the sun. You could help *me*, but what can a poor little moss like me do for you?"

"Oh, you can be of great service to me," replied the fern; "instead of growing apart from each other, let us come together. You bring your velvety, moist leaves to cover my roots, and I will protect you from the hot sun with my long leaves. Then neither sun nor wind can destroy us."

"Gladly," replied the little moss; "I believe we can work together better than alone."

"I will come down from my high place on the mountain to seek you," said the fern.

"Then I will come up from my nook on the moorland to meet you," replied the moss.

Then the fern spread out her leaves to protect the little moss, and the moss stretched her soft green mantle over the strong roots of the fern. The wind blew, but the moss moistened the fern root, the hot rays of the sun poured down, but the fern threw her shadow over the meek little moss.

Both were safe from wind and sun. So they worked and planned together, and from that day to this, wherever ferns grow on mountain, on woodland, or on moor, there you may find the mosses nestling beneath.

LESSON XXXIV

FERNS

After a long walk on a hot summer's day, have you ever stopped and rested in a cool, shady place, by the side of a rippling stream of water? Were you not glad to rest there?

How refreshing was the sight of the sparkling water, and the soft green grass! How pleasant was the gentle swaying of the leaves on the tall trees. It rested and soothed you.

Around you grew pretty green leaves, and at your feet was a carpet of cool moss. On your right was a bank overgrown with lace ferns. The ferns and mosses know the shady, moist places. We shall always find them there.

MAIDENHAIR FERN, SHOWING FRUIT

What a variety there is! The curious hart's tongue juts out from the joints in the stone wall, the delicate maidenhair growing in its shadow. Over in the woods yonder is the hardy bracken fern, filling the dark places with green.

Though they do not bear pretty, colored flowers, there are no plants we love better than ferns. The graceful forms and delicate fronds delight us, and the soft green of their leaves rests us. We like to place them on our tables and about our homes.

Ferns do not propagate themselves like beans and peas. No,

for on the back of each fern frond is a number of tiny dots, brown in color. These are the fruit, or spores, of the fern. The spore is a hard brown case containing a tiny bit of fern substance. When these spores are ripe, they fall on a damp place near the parent fern. The tiny bit of fern substance begins to grow, and splits the spore case and pushes through. In a few weeks it grows into a little heart-shaped scale. Soon fine rootlets appear, and the green scale grows into a fern plant. It takes a long time to do this. Sometimes a year or two is required to bring it to perfection.

SPORES ON FRONDS

A FRUIT-DOT OF A FERN
(Much enlarged.)

Much of the early growth of a fern takes place underground. The fronds are snugly packed in a little roll, which you can see on any fern plant. The frond slowly unrolls, beginning at the base of the fern, and by and by the full leaf appears, tall and graceful, like a long feather.

Watch one some day. Notice the soft meshes of woolly substance that protect it. It is most interesting.

ROOT OF FERN. FRONDS UNROLLING

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While the fronds are unrolling above ground, the underground stem is slowly creeping with its tiny roots under stones and wood. It is searching for moisture for the fern plant.

When next you take a country walk, pull up a fern root. Do not break it, but dig down carefully all around it. Bring it home, and plant it in a cool, moist place. Water it, watch it, and see how the fronds unroll and increase.

Fern Song

Dance to the beat of the rain, little fern,
And spread out your palms again,
  And say, "Though the sun
  Hath my vesture spun,
He had labored, alas, in vain,
  But for the shade
  That the cloud hath made,
And the gift of the Dew and the Rain."
  Then laugh and upturn
  All your fronds, little Fern,
And rejoice in the beat of the rain!

— John B. Tabb.

LESSON XXXV

KINDS OF FERNS

There are hundreds of varieties of these graceful plants. Would we not like to know some of them by name? Would we not like to seek them out in their native home? No plants know so well how to choose their haunts as do the ferns.

You will find them in the lonely, remote places far from the noisy crowd, by the clear brook, in shady nooks, or seeking shelter under a beetling rock or jutting out from cracks in the great rocks.

If we would breathe the pure, fresh air in quiet and peace, let us follow the ferns They will always lead us to the most beautiful spots.

One day's holiday in the woods in our own state of New York will show us from twenty to thirty varieties. Mr. Underwood, a lover of ferns, found thirty-four different species in a radius of three miles near Greene's Lake, New York.

CHRISTMAS FERN

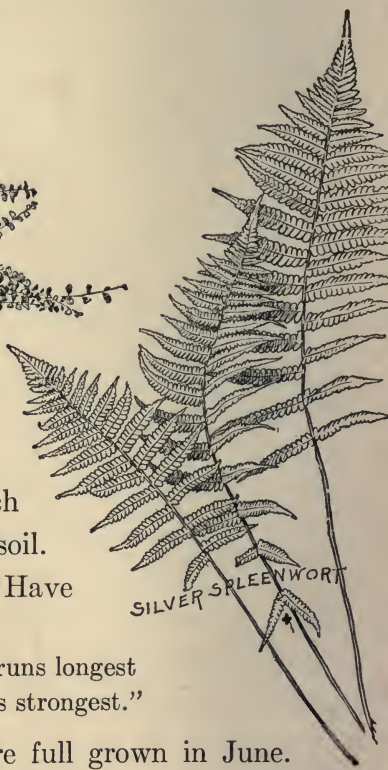
The *Christmas Fern*, so called because it is green all winter, all should know. It has large, smooth, glossy fronds. It grows in rocky woods.

Early in April the *Fiddleheads* push up their big, woolly fronds, and can be found growing in our woodlands.

The *Oak Fern* grows in cedar swamps and wet woods, and is often found near the oak tree.

The *Hart's Tongue* is easily known. It has a simple frond. Its tall, glossy leaves stand almost erect. Sometimes fifty fronds grow on one plant. The fruit dots run in a row on each side of the midrib. They are rich brown in color. This fern grows chiefly among limestone rocks.

The *Spleenwort* is a dainty little fern. You must all have seen it. The Mountain Spleenwort is a tiny fern, growing in the crevices



of rocks. It has strong roots which attach themselves to tiny patches of soil.

The *Lady Fern* grows everywhere. Have you seen it?

> "Where the rushing stream runs longest
> There the Lady Fern grows strongest."

The fronds uncurl in May, and are full grown in June. The bright red stalks stretch up from the shady spots, where it loves best to grow.

We must not forget the *New York Fern*. It is easily known by its short stalk and tapering frond, and the round fruit dots, arranged around the margins of the leaflets. It grows in open marshes or in woods under the shadow of hemlocks and cedars.

Language Lesson

Let the teacher bring in different ferns and exhibit to pupils.
How many kinds of ferns do you know?
What is the name of the fern most often found?
How did the Oak Fern get its name?
Tell something about the Christmas Fern.

LESSON XXXVI

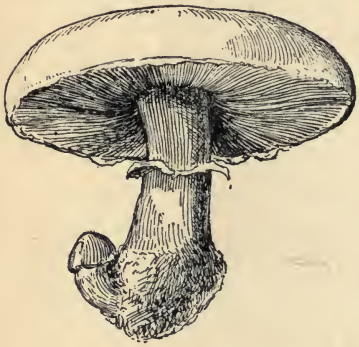
LICHENS

Lichens are a kind of moss. They grow everywhere, on trees, on stones, and sometimes on fences. Their color is a grayish green. They are a kind of fungi. They do not bear seeds or flowers; they grow quickly, and belong to the lowest order of plants. You can find them growing freely in the summer time. Look for them in woody places or on stone walls during your walks in the country. Everywhere you will find things to interest you if you will use your eyes. The gray moss that reindeer live on in the winter months is a kind of lichen. It covers the ground thickly in some cold countries.

Lichens growing on a Rock

LESSON XXXVII

MUSHROOMS



CULTIVATED MUSHROOM

Have you ever noticed in the early morning a funny little plant that looks like a wide-open umbrella, or a plant that looks like an umbrella partly closed? The first plant is a mushroom, wholesome, and good to eat; the second is a toadstool or poisonous mushroom. The true mushroom is very much like an umbrella in shape. It has a handle, a ring, rays on the under side somewhat like the spokes of an umbrella, and it has a top or cover.

The handle is the *stem* of the mushroom, the ring is the *collar;* the rays are called the *gills* of the mushroom, and the cover is called the *cap* of the mushroom. Four things to remember.

The gills of the mushroom spread out from a common center something like the spokes of a wagon wheel, though there are many more. In between the gills lie little brown spores which will later produce new mushrooms. These take the place of seeds of other plants.

When these spores fall on rich soil, they produce fine white cords called *spawn.* This spawn spreads over the soil, and draws up water and nourishment, just like a root; yet it is not a root. From

this new mushrooms grow very quickly. You can see this for yourself if you cut off the stem of a full-grown common mushroom. Lay the cap, gills downward, on white paper. Let it lie for some hours. Then lift it up, and you will find fine brown grains like powder on the paper. These are the spores of the mushroom.

From these spores you can produce new mushrooms. Lay a number of them on good meadow soil. Soon little white cords will appear. This is the spawn. This spawn will spread and spread and draw water and food from the soil. Soon tiny round bodies will appear on these threads. Some are very tiny, like peas; some grow larger, like marbles. These are the *buttons,* or the beginnings of the mushroom.

Clump of Mushrooms

If the buttons are left a while, a cap will grow over them, and a big flat mushroom will result.

Some people pick the buttons before they spread out, and pickle them in jars; some prefer the flat mushrooms. They can fry or broil or stew them.

Some mushrooms shoot up in a single night. Most require only a few days for growth. You can pass through a field one day and not see a single mushroom. They are quietly growing out of sight. The next day you can gather basketfuls in the same meadow. They have come up in the night. The edible mushroom, which grows so

freely in meadows, has pink gills when young, which turn to dark chocolate brown when ripe. It has a white, or sometimes a brown, cap, with a stem and ring. Gardeners cultivate this mushroom. It is much valued in nearly every country.

Many mushrooms are poisonous, so we should not gather them without knowing something about them. Many of the poisonous mushrooms have a cup or bag around the lower part of the stem. You should be sure of them before touching them.

One poisonous mushroom has a cap which turns into a black fluid when ripe. Another kind of mushroom grows very large, with its cap full of dust. This dust is made of tiny spores. Squeeze it, and the spores fly out in all directions. It generally grows on rotten wood. It is called the *Puff Ball Mushroom.*

Another mushroom, called the *Earth Star Mushroom,* grows on the ground, and has the appearance of a starfish. There are many other varieties, all curious and worth studying.

Mushrooms sometimes do mischief. A certain kind of mushroom grows on trees. It pushes its tiny, threadlike spawn into the growing part of the tree and sucks up its nourishment. This causes the tree to fail for want of food. You can see this mushroom fungi on many trees. Look for it.

Language Lesson

What is a mushroom — its color — its parts?
Tell about the spores — how they grow.
Name three mushrooms that are harmful.

The Mushroom and the Oak

Said the mushroom to the oak, "You're very slow!
I dare say it's 'most a year
That you've been growing here —
And I began not quite two days ago!"

Said the oak tree, rustling gently, "That is true,
Through many a winter's snow,
And many a summer's glow,
I've watched the growth of tiny things like you."

Said the mushroom, "May I ask why you're so big?
You really seem to me
As awkward as can be. —
I'd rather far be dainty, wee, and trig."

Said the oak, "My little one, I took the pains
To send my branches high
Up to the glorious sky
To welcome both the sunshine and the rains.

"I struck my mighty roots down deep,
Beneath the frost and snow,
And while storms come and go
They feed me through my long, long winter's sleep."

The mushroom laughed at such painstaking care;
Then there strolled a little maid
Beneath the great oak's shade,
And somehow — soon — the mushroom wasn't there!

G. K.

NOTES OF LESSONS

THE FLOWER

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes
AIM — { to teach parts of flowers.
{ to cultivate power of observation, love of nature.

MATTER	METHOD AND ILLUSTRATION
I. PARTS (*a*) Calyx { Forms outer envelope of flower. Protects inner parts. Is composed of sepals: 1. Divided: buttercup. 2. United: foxglove.	I. (*a*) Provide each child with a common flower (apple blossom, buttercup) in bud; in bloom. Show how calyx protects inner part. Have class notice how sepals are arranged: sometimes below flower, as in strawberry; sometimes above ovary, as in apple.

SECTION OF FLOWER OF BUTTERCUP

FLOWER OF BUTTERCUP

FLOWERS OF THE APPLE

(*b*) Corolla
- Forms second envelope of flower.
- Protects inner parts.
- Attracts insects by color, form, scent, etc.
- Composed of petals:
  1. Separate: rose.
  2. United: hyacinth.

(*b*) Examine *petals*—why colored? why scented? why so beautifully shaped? Show that petals are differently arranged in different flowers.

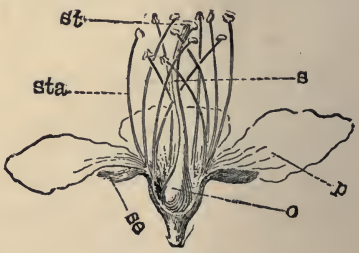
Flower of Lily of the Valley opened

(*c*) Stamens
- Composed of
  - filament or stalk.
  - anther, containing pollen.
- Are placed
  - under ovary.
  - upon calyx.
  - upon petals.
  - upon ovary.

(*c*) Show how filaments vary in length—important part the *anther*. Show anthers and pollen in lily. Show that anthers are inserted differently in different flowers.

(*d*) Important part of flower is *pistil*. Why? Show how seeds called ovules are buried in *ovary;* fertilized by pollen. Tell how pollen sends tube to *stigma* and down style.

(*d*) Pistil
- Ovary
  - lower part of pistil.
  - contains ovules, when ripe forms fruit.
- Style—column joining stigma to ovary.
- Stigma—sticky substance at top of style.



Plum Blossom

se., sepals; p., petals; sta., stamens; o., ovary; s., style; st., stigma.

II. SHAPES
- *Regular*, of three, four, or more petals.
- *Irregular*, butterfly-shaped, bell-shaped, lipped, etc.

II. Show a few perfect flowers. Let class name any prettily formed flowers they remember: foxglove, lily, etc. Show some.

PISTIL OF CATNIP

COMPOUND PISTIL OF ST. JOHNSWORT

SIMPLE PISTILS OF BUTTERCUP

III. ARRANGEMENT
- At end of stalk: rose.
- Both sides of stalk: wistaria.
- Bunched at end of stalk: clover.

III. Ask how flowers are arranged—sometimes singly, sometimes in bunches.

IV. USES
- Protect inner parts of plant, *e.g.* seed cells.
- Attract insects by color, scent, form.
- Add to beauty of landscape and please us.
- Useful as drugs, food, etc.

IV. What would the world be without flowers? They please us and brighten our homes. The petals of some flowers are useful, *e.g.* poppy, camomile, rose.

LEAVES

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes.
AIM — { to teach leaf.
to cultivate power of observation, love of nature.

MATTER

I. PARTS { Leaf stalk or petiole.
Blade: thin, flat.

LEAF OF MAPLE

II. KINDS { Simple — One blade.
Compound — Several on one stem.

METHOD AND ILLUSTRATION

I. Let class bring in several leaves: maple, oak, lilac. How many parts? Describe stalk: smooth, rough, hairy; green, brown, or red. Notice difference in color of upper and lower surface. Why are blades flat? How do they generally hang on tree or bush? Why? Why is sunlight good for leaves? What is the use of *petioles?* Have all leaves petioles? Name a leaf that grows straight from root.

Apex is the point farthest from stem. Name a leaf with pointed apex: with rounded apex. Draw one of each.

II. Show a rose leaf; a horse chestnut leaf. Let class compare with lilac. When only one blade — simple. Name different shapes: heart-shaped, oval, blade-shaped.

Horse chestnut has leaf like a hand — *palmate.*

Rose has several leaves on one stem. Notice margins — *entire, crenate, dentate,* etc.

SIMPLE LEAF

COMPOUND LEAF

PRACTICAL WORK AND APPLICATION

1. Hold to light or paste on window pane, a maple or a tulip leaf. Let class notice direction of veins. Tell them you can tell how many seed leaves plant has by noticing veining.

2. Draw a simple and a compound leaf.

3. What is the use of a leaf to a plant? How many parts to a leaf? What is a simple leaf? Name one. What is a compound leaf? Name one. How do the veins run in a lily leaf?

THE PLANT

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes.
AIM — { to teach parts of plants.
to cultivate power of observation, love of nature.

MATTER

I. ROOT
Nature { Part of plant growing downward.
Formed of rootlets.
Lives in ground.
Use { To feed plant.
To hold firmly in ground.

METHOD AND ILLUSTRATION

I. Show class a plant growing in pot (one that can easily be removed). Let them observe the freshness, stiffness of stem and leaves. Compare with dead plant: leaves flabby, colorless. Compare with plant gathered and left to dry on table. What has happened? Why? Question class as to what holds plant so firmly in ground. Pull it from soil and show *root*, — fibrous ; compare with root of turnip, carrot (which may also be shown). Refer to the plant left on table. Elicit second use of root.

II. Stem
- Nature
  - Part of plant growing upward.
  - Lives in air.
  - Round, square, angular, etc.
- Use
  - To hold up plant to sun.
  - To bear
    - leaves.
    - flowers.
    - seeds.
  - To convey food from root to leaves.

II. Suppose all leaves and flowers were close to root, would plant be pretty? What is needed to hold up leaves? What shape is the *stem?* Are all stems so shaped?

Let class show different stems they have brought in — some round, square, fleshy, wooded, etc.

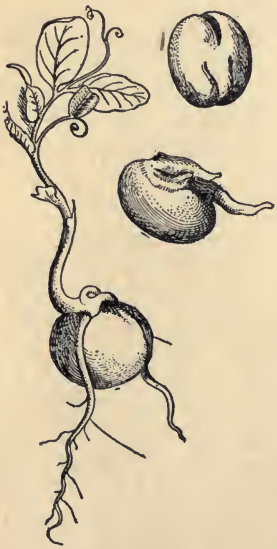
Let class make collection of ten different stems.

III. Leaves
- Nature
  - Flat, green bodies.
  - Fixed on stem.
- Use
  - To feed plant with
    - air.
    - water.
  - To beautify plant.
  - To catch sunlight.
  - To make shade.

III. Which is the prettiest part of plant? what color?

Compare upper and under side of *leaf.* Let class show different leaves brought in. Of what use are leaves? Why do we plant trees along our avenues? Why do cows lie under leafy trees? Read story of "The Mountain Fern," or similar story.

Let class draw illustrations. Collect and mount leaves.



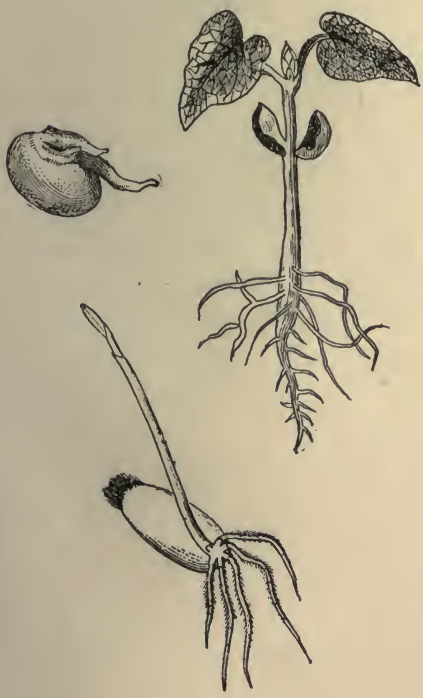
A Sprouting Pea

SEEDS

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes.
AIM — { to teach parts of seeds.
to cultivate power of observation, love of nature.

MATTER

I. { The ripe ovule. It contains baby plant.



PEA, BEAN, AND WHEAT SPROUTING

METHOD AND ILLUSTRATION

I. Collect seeds of bean, pea, melon, peach, apple, etc. Soak over night to soften. Each child should have a pin to use in dissection. Bean : color, shape, size? Find scar where fastened to pod. Is it rough or smooth? hard or soft? Let class draw shape of bean. With pin carefully raise skin. Do not injure baby plant inside. How many coats? Notice little plant within. If planted, baby would feed on thick coat, or *cotyledon*, and send up into air a *plumule*, or stem with two leaves; and send down *radicle*, or root, into earth.

II. Kinds
- Two cotyledons — pea.
- One cotyledon — grass.
- Small round — pea.
- Long broad — bean.
- Hairy — dandelion.
- Silky — milkweed.
- Winged — maple.
- Hooked — chestnut bur.

II. Now open pea; compare with bean, melon, etc. Plant lima beans (*a*) in wet cotton; (*b*) in earth; (*c*) in sand. Let class observe growth and find essentials. Compare bean with wheat seed — only one cotyledon. Plant wheat and observe. Show maple seed, chestnut bur.

Maple Seed

III. Uses
- To reproduce plants.
- As food — bean, pea, strawberry.
- As medicine — poppy.
- As clothing — flax, woolly hairs of cotton seed.

III. Use of wings, hairs, hooks? (To scatter seeds.) Most tropical plants have one seed leaf.

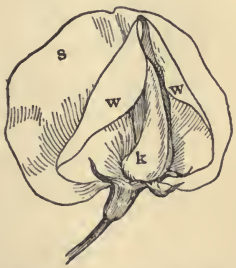
If a plant has no seed, what result? Mention some seeds we can eat. Show cotton seed inclosed in woolly hairs. Make drawings.

Windblown Fruits of Dandelion

THE SWEET PEA

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes.
AIM — { to teach parts of flower of sweet pea.
to cultivate power of observation, love of nature.

MATTER	METHOD AND ILLUSTRATION
I. STEM { Twining, dotted with lighter green, smooth, round, covered with buds.	I. Provide each child with a single flower. Provide teacher with a larger portion, showing stem. Let children discover characteristics. Speak of rapid growth, shown by nodes. Show leaf scars.



SINGLE FLOWER OF PEA
s., standard; w., wings; k., keel.

II. LEAVES { Compound, pinnate, stipulate, alternate, net-veined.	II. Let class examine leaf. Why compound? Compare other pinnate leaves — wistaria, etc. Show stipules. What use?

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III. CALYX	Composed of five irregular sepals — green, cup-shaped, sharply toothed.	III. Now pull off calyx; notice sepals form a cup to hold flower.
IV. COROLLA	Composed of five irregular petals — butterfly-shaped.	IV. Pull off petals carefully; lay on desk; standard — two wings and keel. Let class notice resemblance to butterfly. Think of similar flowers.
V. STAMENS	Ten: nine united by filaments, one alone, inserted on corolla.	V. Notice arrangement of stamens — unlike any other flower.
VI. PISTIL	Ovary — a legume or pod, arranged like a pea pod. Style — long and slender. Stigma — round and sticky.	VI. Ovary is a legume, like pea. Tell class, when seeds are ripe, pod bursts with loud report and seeds are scattered everywhere.

This plant belongs to

I. Class.
Dicotyledons — having net-veined leaves and flowers in fives.

II. Order.
Legume — having seeds in a legume; butterfly-shaped flowers.
Nine long, connected stamens.

Many useful plants in this order:
Food plants — Beans, peas, peanuts, lentils, clover.
Drug plants — Licorice, logwood, senna. indigo, gum arabic.
Timber plants — Locust, honey locust, rosewood.

STEMS

CLASS — 40 pupils.
AGES — 9 to 10.
TIME — 30 minutes.
AIM — { to cultivate power of observation, love of nature.
to teach method of stem growth.

OBSERVATION AND ILLUSTRATION

I. Show any plant with erect stem, *e.g.* geranium. Elicit reason for its position.

Notice texture, whether herbaceous or woody.

Show potato; show eye, will produce leaf bud; hence, potato tuber is underground *stem* full of nourishment for young plant of next season.

Show Solomon's seal — not root but underground stem.

II. Compare erect stem of geranium with *creeping* stem of strawberry. Why does it creep? What is the use of runners? A method of propagating plant. Strawberry, or *strayberry*, strays and creeps along ground.

Show honeysuckle and convolvulus. Elicit the fact that these plants *climb* by means of stems, *twining* around any support they meet. Show how plants of a kind coil alike: in same direction, left to right; others in opposite direction right to left. Ivy always twines from left to right.

INFERENCE

I. USE { To hold plant to air or light.
To carry food from the root to produce buds.

II. MANNER OF GROWTH { Erect.
Creeping.
Twining.
Climbing { by tendrils, *e.g.* pea.
by rootlets, *e.g.* ivy.
by thorns, *e.g.* wild rose.
Underground.

Plants climb by means of tendrils, or little stems thrown out for that purpose. Show common pea plant.

Some plants climb by means of rootlets, which run into any hole or crevice where they may root and get support. Ivy climbs by roots. Show Virginia creepers with little cushions on end of tendrils.

Some plants climb by thorns, like the wild rose.

Wild rose has thorns which catch on neighboring plants that hold it up to sun and light.

Have children notice hairs on stem. What are they? Use? Thorns or prickles on stem. Use? (Protection against insects, animals.)

Elicit use of stem and plant.

III. Show how rootlets feed roots, which send sap to leaves through stem. How are leaves held up to sun and air? Why should they be so held up?

Value of stem of plant to man. Think of sugar cane. Show cane; dried sap of sugar palm. Show maple syrup drawn from stem of maple tree. Camphor from stem of camphor tree of Japan. Quinine from stem of cinchona.

Strong saps obtained from trunks of trees — tar and turpentine from pine tree; cork from bark of cork trees; flax from flax plant; rubber, gums, resins, from various trees.

Stems vary in shape. Stems of plants generally round.

Show stem of mint plant (angular).

Show stem of sweet pea.

Stem of Nightshade

III. Use of Stem
- (*a*) To plant
  - Holds plant to light.
  - Holds plant to air.
  - Carries sap from roots.
  - Produces leaf buds.
- (*b*) To man
  - Food.
  - Medicines.
  - Manufactures.

Stem of Wallflower

Stem of Rose

APPLICATION

Mention a plant that climbs by its tendrils.

Mention a plant that climbs by its roots.

Mention a plant that climbs by its thorns.

Difference between a climbing and a twining stem.

What plant has a prostrate or creeping stem? Tell about it.

What use do we make of underground stems?

Stem of Sweet Pea

NEEDS OF PLANTS

Class — 40 pupils.
Ages — 9 to 11.
Time — 30 minutes.
Aim — { to cultivate power of observation.
to cultivate interest in nature.
to teach needs of plants.

OBSERVATION

I. Place two beans, two peas, two almond seeds, which you intend to germinate, in pots, the soil being alike in all the pots. Put one lot one inch underground *in darkness*. Put other lot above ground, *in bright light*. At intervals of a day or two, note growth. It will be found that seeds buried in darkness have germinated while those exposed have merely swollen. Let

INFERENCE

I. Germinating Plants need { Moisture.
Air, containing oxygen.
Darkness.
Warmth.

class discover cause. Darkness + heat + moisture are necessary to germination.

II. Bring into room two cut flower stalks with leaves—geranium or bean seedlings. Place one in glass of water. Let other lie on desk. At end of hour compare. Draw from class cause of wilted condition. Same conditions occur when plant is grown in dark cellar. Refer to potato budding (buds white); white stems of celery. (Show celery and potato.) Hence, light and heat necessary to form green coloring matter in plants. Refer to loss of green in leaves in Fall, when sun's rays grow weaker. What happens when plants are not watered? when grown in darkness? Why do they die?

III. Food of two kinds, *liquid* and *gaseous*. Ask class how obtained—from soil, through roots. Show by illustration how roots draw up water. Show how water in soil dissolves minerals (refer to sugar in tea) through which it passes and feeds plant with this enriched moisture. Hence, wheat contains *potash*. Show mineral solution. Many plants contain *iron*. All get *ammonia* through rain water.

Gaseous food obtained from air through leaves and stem.

Explain how under influence of light and heat plants make starch on which they live.

Explain work of leaves by day, breathing in gaseous food from atmosphere, and breathing out different substances at night. Show stomates or breathing pores of leaf. Illustrate by immersing a leaf in water.

II. Growing Plants need
- Moisture.
- Air.
- Light.

Which give
- Liquid
- Gaseous

} food.

III. How obtained
- Moisture from rain and soil through roots.
- Air from atmosphere through leaves and stems.
- Light from atmosphere through leaves and stems.
- Warmth from atmosphere through leaves and stems.

Stomates or Breathing Pores of Leaf

See bubbles of oxygen given off by leaves while making starch. Deduce from class necessity of air to furnish these gases and of light and of warmth to change them so as to be of use to plant.

Hours could be spent on the subject of "Needs of Plants." The above will be sufficient as an introduction. Encourage children to try experiments for themselves.

APPLICATION

What things do plants require for germination?

How does the plant get food?

In what form does the plant take in food?

PROPAGATION OF PLANTS BY SEEDS

CLASS — 40 pupils.
AGES — 9 to 11.
TIME — 30 minutes.
AIM — { to cultivate observation.
to train reasoning powers.
to teach growth of plants from seeds.

OBSERVATION OR METHOD

I. Plant beans or peas in soil. Watch growth. Plant mustard seed, bird seed, wheat seed, on wet sponge or moist sawdust; watch results. Encourage pupils to plant seeds in school or home gardens, — nasturtium, morning glory, or any annual, — and note results.

Cut up a few sheets of paper and make note books, with paper covers. Provide each child with a note book and let pupils make reports on progress of plant growth.

Draw inference that most herbaceous plants grow quickly from *seed.*

INFERENCES OR FACTS

I. NATURE OF SEED { The fruit of the plant.
The baby plant and food.
The germ of new plant.
Reproduction of species.

GERMINATION OF PEAS

II. Soak beans over night. Give one to each pupil with pin for dissection. What is bean? color? shape? size?

Find *scar* where fastened to pod. Is it rough or smooth? hard or soft? Find little hole where pollen tube entered.

Put pin in. With pin carefully raise skin. Is it thin or tough? How many seed leaves? Are they thick or thin? Why?

Do not injure baby plant. How many parts has it? radicle or root, plumule or stem? Plant it. Watch it.

II. Parts
- *Scar* by which it was attached to pod.
- *Micropyle*, or gate, entrance for pollen.
- *Cotyledons*, or seed leaves with thick skin.
- *Baby plant* with plumule and radicle.

III. Radicle goes down. Plumule grows up. Why two leaves? Plant (*a*) in earth; (*b*) in cotton; (*c*) in sand. Compare growth.

Compare bean with wheat seed.

Wheat has only one cotyledon.

Plant wheat and compare growth.

Most tropical plants have only one seed leaf.

APPLICATION

What is a seed?

Describe a bean seed.

How does a bean germinate and grow?

Draw a picture of a bean seed.

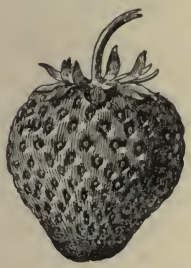
Draw a bean seedling.

III. Germination
- Place in favorable condition: heat; moisture; air;
- Bean swells and bursts outer coat;
- Plumule goes up into air to hold leaves;
- Radicle goes down into ground to seek food for young plant.
- Two tiny green leaves appear and plant begins independent growth.

PROPAGATION BY RUNNERS

CLASS — 40 pupils.
AGE — 9 to 11.
TIME — 30 minutes.
AIM — to cultivate power of observation, love of nature.
to train reason and judgment.
to teach propagation of plants by runners.

OBSERVATION. METHOD. ILLUSTRATION



Ask pupils to visit a strawberry bed and report what they have seen — the plant, the fruit, the white runners. Or grow plant in a box on class-room window. Ask pupils to examine wild strawberry bed. Watch growth. Report observation.

INFERENCES

WHAT ARE RUNNERS?
- Small shoots sent out by strawberry.
- Run along ground for a distance.
- Known by pale green appearance.
- Push end downwards into soil.
- Root, then send up new plant.

Some days later (when interest is awakened) bring into class, or have pupil bring in, a strawberry plant. (Easily obtained from florist.) Show how plant grows with leaves and fruit closely packed together. Show runners thrown out by plant. Explain that these spread out until they find a suitable place, when they root and throw out new leaves and flowers, and become plant. (Draw while talking and show runners rooting.)

VALUE OF RUNNER
- Of no value to parent plant.
- At first draws sap from parent plant.
- Are cut off by gardener.
- At end of season a few left to root.
- After rooting removed to make new plants.
- Grow quicker than from seed.
- Produce healthier plants.

STRAWBERRY PLANT

In cultivated plants gardeners cut off these runners. Why? At Fall of year, when fruit is ripe, these runners are allowed to root. Why? Then carried off as young plants to make new strawberry beds. These blossom and fruit the following year and produce strong, healthy plants like the parent plant.

Plants grow quicker from runners than from seed. Gardeners take advantage of this and plant them.

PRACTICAL WORK AND APPLICATION

1. Let class make drawings and observe growth when opportunity occurs, either in class room or at home.

2. What is a runner?

Mention a plant that propagates by runners.

How does a runner produce new plants?

What is the use of a runner to a plant?

Why does the gardener plant runners?

PROPAGATION BY SLIPS

CLASS — 40 pupils.
AGE — 9 to 11.
TIME — 30 minutes.

AIM —
- to cultivate power of observation, love of nature.
- to train judgment and reasoning powers.
- to teach propagation of plants by slips.

INFERENCE. MATTER

I. NATURE OF SLIP
- A young plant or shoot growing on healthy plant.
- Must have healthy growth layer.
- Should be cut from plant in early Fall.

II. WHY MADE
- Because growth more rapid than from seed.
- Because growth produces same plant.

III. PREPARATION — Plant in prepared soil in
- warmth.
- moisture.
- air.
- darkness.

GERANIUM SLIP

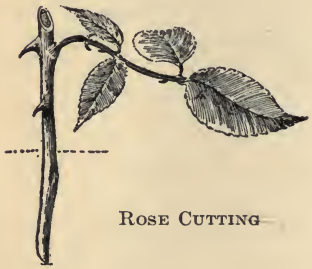
OBSERVATION. METHOD

I. Bring into class room (or better, have pupil bring) a healthy geranium plant. (They can be had for asking in public parks in September.) Show entire plant — strong, fibrous roots; thick, herbaceous stems; broad, green leaves.

II. Have ready three or more flower-pots. Turn over pot and let class observe hole in bottom. Why? Have pupils throw in some pieces of glass or pottery to make drainage. Why? Partly fill with fine prepared soil.

III. Choose a small healthy-looking shoot. Slip it, or cut off obliquely. Why? Let pupils drill hole with round stick. Why? Now put in slip. Press soil tightly but gently round slip. Why? Carefully moisten with water. Fill in remainder of soil. Do not fill to brim of pot. Why? Cut off lower leaves. Why? Slip is now ready for growth. Where shall we put it? Why not put in light? Why not in cold?

IV. How it grows
- Cut off lower leaves to stay evaporation.
- Slip forms rootlets which feed plant.
- Leaves will form and new plant grow for springtime.



Rose Cutting

The Slip Growing

IV. Examine frequently; water occasionally.

Look for new leaves in week or two.

N.B. It is well to plant several slips and compare growth.

Let pupils cut off remaining slips and plant them. Put all these cuttings where they can have warmth, air, moisture. Compare results.

Encourage pupils to do same thing in their homes.

Let pupils find out what other plants are propagated by slips rather than by seeds. (Honeysuckle, chrysanthemum, rose, begonia.) Why?

Cut off a slip and plant in water. Compare progress.

Hang up near window, where class may watch and note growth of roots. Compare with slips planted in soil.

APPLICATION

Name a plant often produced from slips.

What is a slip?

Why are slips planted?

How does it take root, and grow?

Describe the growth of a slip you have seen planted, or one you have planted yourself.

FERNS

CLASS — 40 pupils.
AGE — 9 to 11.
TIME — 30 minutes.
AIM — { to cultivate child's power of observation.
to interest in nature study.
to give simple knowledge of ferns.

MATTER	METHOD AND ILLUSTRATION
I. PARTS { *Fronds*, or outspread leaves. *Spores*, on underside of leaves. *Rhizome*, or underground stem. *Rootlets*, attached to rhizome.	I. Let teacher bring, or have brought to room, several growing ferns in pots. Let children notice long spreading leaves — brown stem holding tiny leaflets; teach name — a frond. Let class note full-grown frond. Let them notice unrolled frond. Notice tiny hairs on each when in roll. Why? (To protect from cold.) Turn over leaf and notice brown spots below. What are they? Notice fern has no flower, hence fronds must produce seeds. Tell class they are not real seeds, but will by and by make a *sort* of seed. They are therefore inferior to flowering plants. Now show a bracken fern — the whole plant. Let class notice the strong underground stem or rhizome. Explain how it pushes its way underground. Show little root hairs.

ROOT OF FERN

II. COLOR { When young — light green. When older — darker green. Sometimes variegated. Midrib — glossy brown.	II. Compare color of fern with flowering plant; frond always green. Some, like maidenhair, are of a delicate green. All become darker green after attaining full growth. Show midrib.

III. Spores
- Spore in spore case contains germ of new fern; produces fern prothallium; gives birth to embryo fern plant.
- Germinate on damp ground or rotting wood.
- Produce new fern.
- Inferior to a seed.

Spores on Fronds

IV. Practical Work or Application

III. Provide each child with a frond and let the pupils cut off spore cases and examine them. Each spore case contains many tiny spores. Spores ripen and fern substance pushes through — grows into tiny heart-shaped bit of tissue. (Draw on blackboard.)

Young fern grows from a *prothallium.*

Explain briefly formation of embryo fern. One leaf rises above ground, while root strikes down into soil.

Gardeners raise thousands of these plants from spores yearly.

Show tiny ferns thus grown. Compare arrangement of spores of maidenhair with spores of bracken. Show both. Note same on edge of leaflet — others along midrib.

Prothallus of Fern

IV. 1. Let children gather fronds. Compare setting of spores. Press and draw fronds.

These ferns can easily be found by children in near-by woods. I have never had any difficulty in getting pupils to bring specimens.

2. Have class visit fernery in Botanical Gardens at Prospect Park or Bronx Park and write about what they have seen.

MOSSES

CLASS — 40 pupils.
AGE — 9 to 10.
TIME — 30 minutes.
AIM — { to train observation.
to cultivate reasoning powers.
to give elementary knowledge of mosses.

OBSERVATION

I. Let teacher or pupils bring into room any mosses which they have gathered in the woods, or on decayed stumps. Hold up to light, and notice tiny leaves, somewhat shape of fern fronds. Note tiny stem. Observe how tightly and closely the roots are matted.

Tell children mosses cling to rocks more closely than oak roots to the soil. Show how this is an advantage to places they cover. Roots require little soil and grow rapidly. Mosses are one of the simplest forms of plant life.

INFERENCES

I. PARTS {
Leaves — tiny.
Stem — short.
No seeds — but spores in capsule.
No flowers.
Roots — fibrous, tenacious.

MOSS CAPSULE SHEDDING SPORES

II. Compare club moss (of delicate green) with bearded earth moss (white on account of white hairs or leaflets). Bog moss of Ireland is a grayish green. Color varies from gray green to reddish green. Encourage children to collect and compare mosses. Over 3000 species are known.

III. Bring in a mat of moss in fruit.

Note little stalks rising from leafy stem.

Provide each child with one. What do they bear aloft?

Raise pointed hood.

Observe capsule. Raise with pin.

Notice tiny teeth on edge. Empty capsule, and grains of dust will fall. These are *moss spores*. Plant on damp ground and watch for threadlike growth, like scum. From this will arise a new moss plant.

Draw attention to greenish scum children have noticed on tree trunks. These are young mosses.

IV. Elicit from class places where mosses grow. Why do they choose damp soil? why barren rocks? (Little soil needed — simple nature of plants.)

V. Draw from class what becomes of dead moss. Compare with fallen leaves in autumn.

Show how mosses fertilize barren places. Show how their tenacious roots hold together rocks and stones, and prevent crumbling. Tell of the bog mosses of Scotland and Ireland. Tell of Arctic moss. Show how they absorb rain, and prevent floods, and how they give off rain and prevent drought.

II. Color
- Delicate green — when young.
- Dark green — when old.

III. Spores
- Contained in capsule, raised on summit of stem.
- When ripe, fall out as tiny grain.
- Feed on damp ground.
- Produce tiny threadlike plant buds.
- Buds grow into new moss stem.

IV. Growth
- On moist, damp ground.
- On old tree trunks.
- On roots of ferns.
- In cracks in old walls.

V. Uses
- To make soil and in time give rise to higher forms of plant life.
- To bind together rocks and stones and preserve from frost.
- To soak in rain and prevent floods.
- To protect roots of plants and trees.
- To furnish food for reindeer.
- In some countries used for fuel, *e.g.* peat and bog moss.

VI. Practical Work and Application

VI. 1. Let class collect and press moss. Let class make drawings of any part of moss plant.

While describing evolution of spore, make drawings (no matter how simple) on blackboard. Interest is maintained.

2. Visit gardens in public parks, *e.g.* Prospect Park, Bronx Park, and find wonderful collection of mosses.

MUSHROOMS

Class — 40 pupils.
Age — 9 to 10.
Time — 30 minutes.
Aim —
- to cultivate power of observation.
- to interest in lowly things in nature.
- to give elementary knowledge of mushroom growth.

INFERENCES	OBSERVATION AND ILLUSTRATION
	I. Bring into class room (or better take class to wood, where they can study naturally) several common mushrooms — full-grown; also some buttons. Provide, if possible, each scholar with a mushroom. Note *odor*. Pass finger along top of stem. Note smoothness.
I. Parts — *Head*, or top, smooth. *Gills*, running like rays from stem. *Ring*, at base of gills. *Stem*, thick, short, solid, white, smooth, leafless.	
	II. Note color, texture, surface, length. Examine gills. Note color in young mushrooms; in old mushrooms. Examine ring. Why is mushroom so light? so soft? Note absence of leaves, flowers, seeds. Mushroom belongs to lowest order of plants. Flowerless, seedless. Tell about *ink* mushroom, about edible and poisonous mushrooms.
II. Color — Varies from white to brown to black. In common mushrooms gills turn from pink to dark brown. Stem — white or light brown.	

III. SPORES

- Found in gills of mushrooms.
- When ripe, fall out like grains of powder.
- Feed on damp soil, and produce spawn.
- Spawn spreads and feeds on water.
- Tiny buttons develop.
- Button grows rapidly into mushroom.
- Simplest form of plant life.

III. Lay a ripe mushroom on a sheet of paper. Shake out spores, brown, or black, or white. Compare with spores of fern and moss. No seeds. If spores are placed on suitable soil, will produce strings of white cord called *spawn*. Spawn spreads and feeds and takes up water like a root; is long time developing. Compare root of bean with spawn. Show difference in germination. Look for buttons on spawn. Show buttons to class. Tell the class these are beginnings of new mushrooms. Have class look for spawn in woods, or on decayed trunks of trees. Tell how fungus spawn often destroys trees.

Warn pupils against indiscriminate gathering of mushrooms. Tell of rapid growth from *button*. Full-grown mushrooms can develop in one night.

In some countries considered a delicacy.

Many persons earn livelihood cultivating mushrooms.

PRACTICAL WORK AND APPLICATION

Encourage pupils to visit a mushroom gardener and watch growth.

Describe the growth of a mushroom from a spore.

What is a mushroom button?

Describe a mushroom — the head, gills, ring, stem.

Are all mushrooms edible? Which are not?

For what purpose are mushrooms grown?

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